CURRENT SCIENCE

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The Indian Chemical Industry

THE ten weeks since the declaration of the War, have been witnessing a steady inflation in the price of drugs and chemicals in this country. The manufacturing industries whose maintenance is largely dependent upon the import of foreign accessories and raw materials, have already begun to feel the pinch of a diminishing supply of their essential needs. The Conference of Chemical Manufacturers held recently at Calcutta, under the auspices of the *Indian Chemical Manufacturers' Association*, has focussed the attention of the public on the imminent shortage of drugs and chemicals in India. The country has now become painfully conscious of its large dependence upon foreign sources for its supply of the principal drugs and chemicals.

The country was confronted with a similar crisis twenty-five years ago, during the Great War of 1914–18. Since then, the Indian Chemical Industry has made some progress; the pharmaceutical industry, for instance, has been trying to establish itself and has survived keen foreign competition; small nuclei of heavy chemical industry which now exist in the country, are manufacturing sulphuric acid; one or two works for the manufacture of alkali, are also under active consideration. But these could satisfy only a small fraction of the growing needs of the country. At the moment, India consumes, annually, about five crores rupees worth of drugs and chemicals, of which at least seventy-five per cent. is imported from abroad.

The Chemical Industries in India group themselves into three main classes:—(1) Those which are in the process of establishing themselves on a fairly firm foundation,

(2) those which are yet in their infancy and which, on that account, require careful protection and consolidation and (3) those which await exploitation. The pharmaceutical industry which falls under the first group, is in immediate need of rapid expansion to satisfy the increased demand caused by the total stoppage or partial curtailment of imports. The development of this industry, which is urgent, could have been easily secured, if we were not obliged to depend upon foreign sources even for some of the basic raw materials. The textile industry is faced with a similar situation because of the rapidly diminishing supplies of wetting. bleaching and dyeing materials.

Many of the industrial enterprises now flourishing in the country can continue to function only if an unrestricted supply of the imported raw materials and spares of manufacturing machinery is ensured. It would be difficult to point out one single chemical industry in this country which can be considered self-sufficient and which will not be more or less crippled for want of foreign supplies. This unhappy state of affairs is the natural consequence of the policy of wholesale transplantation of industries which the country has been adopting in the past. There have been several instances in which even erecting engineers and technical experts have been imported to run the industry. The adoption of such a policy was no doubt necessary at a time when the industries were still undeveloped. Very few of the industries can claim to have originated through our own creative effort, which has yet to play its part in the future development of industries.

It may be said that the country is now on the threshold of the second stage when the creative faculty, latent in the country, should be stimulated and mobilised for the promotion of industrial advancement. This is not going to be an easy task for a country which has so far lacked competent, disinterested and broad-minded leadership in this field of national economy.

The next phase of industrial development in this country should consist in the consolidation of the existing industries; they should be rendered less and less dependent upon foreign imports. Subsidiary industries helping to produce accessories and intermediates should be organised. The possibility of utilising substitutes of Indian origin should be intensively and systematically explored. In the domain of pharmaceuticals, for example, it would be easy to find substitutes, perhaps more efficacious, but the industry is yoked under a highly conservative British Pharmacopœia. It is for the *Indian Medical Research Council* to take up this matter and examine the situation.

The designing and fabrication of chemical plant and machinery leading to the establishment of chemical engineering industries in the country, should be immediately taken up for serious consideration. The country possesses the necessary equipment and talent; we have large foundries and machine shops and skilled and capable workmanship is available. We may be lacking in some of the specialised materials of construction like stainless steels and special alloys, but we could, for the moment, do without them. It is a matter of profound regret that the Central Government could not see their way to subsidise Sir M. Visvesvaraya's scheme for founding an automobile industry in this country, as this would have facilitated the establishment of the chemical engineering

industries by providing the necessary background. The present opportunity should not be lost in laying the foundations of this industry on sound lines.

The Government of India have suggested that Indian Manufacturers might prepare a consolidated statement of their requirements of heavy chemicals and obtain them through Messrs. *Imperial Chemical Industries,* who are in close touch with the world markets with regard to these commodities. While this arrangement will provide a temporary and easy solution to the problem, this remedy will, in the long run, prove worse than the disease, as it will only serve to perpetuate our dependence on foreign supplies to nourish our industries. The Central Government should take a broader and more generous view of the problem and help the establishment of these key industries in the country. Such a step would be in the best interests not only of India, but also of the Empire. The industrial prosperity of Canada, Australia and other Dominions, has proved to be a source of great strength to Britain in the present crisis; flourishing chemical and engineering industries in India would, in a similar manner, constitute great assets to Britain in war as well as in peace.

It is for the Central and Provincial Governments to move in the matter of organising and mobilising the material resources and technical talent and help the country to enter on the second phase of industrial development. It would be a grievous mistake if the Government should lose this opportunity. A Board of Scientific and Industrial Research or a National Research Council should be constituted to deal with all the aspects of the problem. The *Industrial Research Bureau* which is now miserably staffed and financially starved, may be reconstituted into a bigger and more comprehensive body and provided with ample funds to finance schemes of industrial research.

Biological Abstracts

THE announcement that *Biological Abstracts* will undertake a more complete abstracting of current literature in bioclimatology and biometeorology will be welcomed by research workers interested in medicine, public health, ecology, agriculture, forestry, botany or zoology, geography and other sciences. The increasing interest in climatic and meteorological factors in their relation to biology, medicine and agriculture is one of the significant trends of modern science. Ecologists, foresters, horticulturists and entomologists are all concerned with the interrelationships between climatic and meteorological factors on the one hand and the organism with which they work, on the other. Increasing attention is now being paid to bioclimatology and biometeorology in various countries and the situation necessitates the ushering in of a mechanism for bringing together the scattered literature in this field. The abstracting journals of broad scope like *Biological Abstracts,* are admirably suited for such a synthesis and by inaugurating this service *Biological Abstracts* will be fulfilling a very important function.

The section Bioclimatology-Biometeorology will appear within the section Ecology in *Biological Abstracts,* and will be edited by Mr. Robert G. Stone of the Blue Hill Observatory, Harvard University. Under the sectional publication plan, this material will be found not only under Section A, "Abstracts of General Biology", but also under Section B, "Abstracts of Experimental Animal Biology", Section D, "Abstracts of Plant Sciences" and Section E, "Abstracts of Animal Sciences".

Some Aspects of the Chemistry of the Vibrios

By Richard W. Linton

(*Department of Pathology, Cornel University Medical College, New York*)

I PROPOSE to review in this paper a series of researches on the cholera vibrio which were carried out in India under my direction between 1931 and 1938. They were supported by grants from the *Indian Research Fund Association*, and the material upon which the paper is based was published in the *Indian Journal of Medical Research* during those years.

When the study commenced in 1931 we were faced with a heterogeneous mass of vibrios, some named and some numbered, some isolated years before and some newly isolated, from highly fatal epidemics or mild cases, some from the beginning and some from the end of epidemics, others from carriers or from water. With the information then available it was impossible to make any useful differentiation of these vibrios or to say which was dangerous and of epidemiological importance and which was harmless.

Another aspect of interest in the cholera problem at that time was the question of variation. Workers in India were then much interested in bacteriophage, which was being widely used as a therapeutic agent, and under the influence of 'phage, in the laboratory at least, the vibrio appeared capable of an extraordinary range of variation; and these variants were themselves objects of speculation as to their relation to cholera.

At that time we did not have the advantage of any useful knowledge of vibrio serology, such as has been obtained during more recent years through the work of Gardner and Venkatraman and Bruce White, although this work itself, as is now becoming evident, was too narrowly based to stand up under accumulating field experiences. In our own work, it was accordingly necessary to choose strains at random, since there was only the slightest information, at first, as to what their potentialities might be in the cholera problem.

Our first work was on the isolation of polysaccharides from the vibrios; later as the work expanded we undertook the study of vibrio proteins, of vibrio metabolism and finally of the chemical basis of vibrio variation.

Leaving aside the technical details of the isolations, I may point out that of over 300 vibrio strains from all sources, three polysaccharides were obtained. As far as we were able to carry the analysis, these appeared to be made up of the following constituents: (1) Galactose plus an aldobionic acid consisting of galactose and glucuronic acid; (2) Arabinose plus an aldobionic acid consisting of galactose and glucuronic acid; (3) Glucose alone, no aldobionic acid. The first two of these were reported in 1932 and the last in 1935, although it is probable that this polysaccharide was identical with one isolated by Jermoljewa and Bujanowskaja in 1930, who tentatively identified glucose in the hydrolysis products. These polysaccharides vary in nitrogen content between 3% and 6%, with about 0·6% of amino nitrogen. Landsteiner and Levine found a nitrogen content of 4·3% in the vibrio polysaccharide which they isolated. These structures are acetylated in the cell, and have distinctly different specific rotations.

In the same large group of vibrios, a study of the proteins was next undertaken. The well-known complexity of the proteins seemed to afford an opportunity for an almost unlimited capacity to break down into a number of fractions. Rather than do this, however, we chose to take the protein as a whole, and see if any differences could be found between proteins from various vibrios from different sources. We applied Woodman's technique to these proteins, and found that no matter how many vibrios we studied we obtained only two curves, and that these curves correlated with the source in nature, or one might say, with the epidemiological source of the organisms.

We had thus three polysaccharides and two proteins among the vibrio group as a whole. Each individual vibrio appeared to be made up of one polysaccharide and one protein. We accordingly had the possibility of six groups among these organisms,

and over the course of several years, all six of these groups were found. For example, after three of the groups had been formed, it was possible to predict the existence of a fourth group, and several months afterwards upon the analysis of some carrier strains from El Tor in Egypt, vibrios were found which conformed to this chemical composition. In the same way, the discovery of the glucose-containing polysaccharide, which came after the work had been in progress for three years, permitted us to predict the existence of the sixth group, and eighteen months later on analysing some vibrios from China, this group was found.

Having thus been led to form groups and divide the vibrios according to their chemical structure, it was important for our hypothesis to pursue other lines to see if we could strengthen our work, or if we should modify our conception. These further researches, which in large part went on at the same time as the chemical analyses, and were an integral part of them, followed three lines: evidence from epidemiology; evidence from the metabolic activity of the vibrios; and evidence from variation.

The evidence from source or epidemiology showed us that vibrios having the chemical structure of groups I or II invariably came from cholera cases, in recent isolation; that is, not from old laboratory strains which might have come from cases years previously; also in these groups were vibrios from people who had been in recent contact with cases, in the same house for example. Group II vibrios are rather rare in our series, and hardly appear in Calcutta during the annual cholera epidemic at all; on the other hand, their isolation from highly fatal epidemics in Assam indicates that they have an important part in some places in the disease. Strains from water were generally found to have the group III structure, although, as one would expect, since cholera is often a water-borne disease, vibrios of the first two groups were occasionally found. Strains from chronic carriers, from El Tor and from carriers in India and China were found to have the group IV or V structure; specifically, the El Tor strains were of group IV structure. It was of interest to study these strains and to show that they were related to the cholera vibrios of group I by having the same polysaccharide, and to the water vibrios by having the same protein. Our analysis showed that chemically the strains were the same in the earlier isolations at El Tor thirty-five years ago, and the isolations of 1930–32. Old laboratory strains from cases, or case strains which had been made to vary artificially generally were found to possess the group VI structure. Accordingly before the work was ended, it was possible to predict with a good deal of accuracy just what chemical structure a strain would possess, when its source was known. In short we had a constancy of protein and polysaccharide in relation to source which strengthened the validity of the groups.

The evidence from metabolism consisted in brief of differences which were constantly present between the different groups, although the separation was not as complete as it was on the basis of chemical structure. Anaerobic glycolysis appeared to be constant in all the vibrios, but there existed regular differences in respiration and aerobic glycolysis. It was interesting to find that the group IV carrier strains did not show any aerobic glycolysis.

Altogether, something over two hundred strains were studied by metabolism methods, and it was found that 98% of the case strains and 100% of the contact strains fell into the same group and chemical analysis showed that these were groups I and II of the chemical classification, or, if the strain had been for some time in the laboratory, group VI. Strains with another level of metabolism were carrier strains, and with a third were water vibrios. It appeared again that we had differences between vibrios consistent with the groups which appeared on the basis of the chemical analyses.

The subject of variation in the vibrios and its chemical basis is a large one, and occupied us for several years. In general, the method was to take a strain of known chemical composition, metabolism, colony form, biochemical reactions, serological reactions, etc., and either study its spontaneous dissociants, or force dissociation by any of the well-known methods and then study these dissociants in the same way. As an example of spontaneous dissociation, I may give the following: In April 1935, chemical analysis of strain 1200, which had been isolated in the previous December, showed that it belonged to group VI, *i.e.*,

its polysaccharide was of the glucose-containing type. In May 1936, thirteen months later, after undergoing routine subcultures, a second analysis was made and indicated the presence of a large amount of galactose accompanied by some glucose in the hydrolysate of the polysaccharide. A third analysis in January 1937, twenty-five months after isolation, showed only galactose in the hydrolysate. At the same time, the strain had shifted its serological reaction and now agglutinated only with an antiserum to another galactose-containing organism, whereas on first isolation it had reacted only with antiserum to a glucose-containing organism. In other words, the shift in its chemical structure had been reflected in its serological reactions.

Very many experiments of this type, and also with single-cell cultures and forced or spontaneous dissociation showed us that variation had a chemical basis in the vibrios. In the case of single-cell cultures, we began with a culture descended from a single cell and having a certain set of characteristics: biochemical, cultural, serological; and a certain chemical structure. At the end of the experiment we had produced from this culture a new strain having another set of biochemical, cultural and serological characteristics, and a different chemical structure. It followed that the new strain fell into a different chemical group than the old, and I wish to emphasize that all the characteristics of the new strain were similar to those of other strains in the chemical group into which it now fell. In other words, the changes in chemical composition, biochemical reactions, cultural and serological properties are correlated.

It is of interest to note further that while the vibrios vary in this correlated way, they always remain within the framework of the six chemical groups, that is, within the framework of the two proteins and the three polysaccharides. Within these limits the powers of synthesis and variation are considerable, but the organisms appear incapable of giving rise to any other chemical constituents. The conception is that of a strictly limited capacity for transformation.

To return, in closing, to the present situation in the vibrio group in contrast to that which I outlined at the beginning of this paper, we have been able to divide the vibrios into a small number of groups, which correlate with their epidemiology and metabolic activity. This result is in contrast to the large number of heterogeneous groups which have always resulted from purely serological attempts at classification, a number which varied directly with the number of strains which were being studied. For recent examples of this statement, the papers of Taylor, Pundit and Read, and of Mertens and Mochtar may be consulted. The former found that 33 "O" antisera were insufficient to classify 558 vibrio strains, while the latter could not classify 32 strains using 17 antisera. Finally, some order has been brought into the subject of vibrio variation, the limits of this variation appear to have been established, and transformation of vibrio strains has been shown to occur in the laboratory.

Any account of our research would be incomplete without mention of those whose unceasing efforts over a period of years enabled the facts to be elucidated, and I accordingly take pleasure in adding to this paper the names of Dr. D. L. Shrivastava, Dr. B. N. Mitra, Dr. S. C. Seal, Jemadar Harwant Singh, and Messrs. S. P. Mookerji and D. N. Mullick.

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The Problem of Opium Addiction in India and Its Treatment

By Brevet-Col. R. N. Chopra, C.I.E., I.M.S. (R.), M.A., M.D., Sc.D. (Cantab.), F.R.C.P. (Lond.)
(*School of Tropical Medicine, Calcutta*)

OPIUM and poppy were introduced on the west coast about the ninth century A.D., by the advent of the Mohammedan traders, and opiates soon came into use. A study of records shows that during the period of the Moghul Empire, alcoholic beverages, opiates and hemp drugs were freely used. A decoction made from poppy capsules known as *koknar* was extensively used all over India. Opium, on account of its stronger effects, appears to have taken a great hold of the people.

Most of the raw opium sold in this country is used for addiction purposes in one form or another. The present use of opium in India may be considered under five main headings:—(*i*) Opium eating, (*ii*) opium smoking, (*iii*) poppy drinking, (*iv*) addiction to opium alkaloids, and (*v*) administration of opium to infants.

(*i*) *Eating of opium* is the favourite method of indulging in the drug. The common practice is either to pound the drug, mix it with water (*Kasumba*) and drink it or take it in the form of a pill. From the figures I have collected all over India it appears that the consumption of opium, if the country is taken as a whole, is very low, but curiously enough there are certain areas where it is very high. The areas of high consumption are Calcutta, Hooghly, Howrah and 24 Parganas in Bengal Presidency; East Godavari and West Godavari in the Madras Presidency; Ferozepore, Lahore, Ludhiana and Amritsar in the Punjab; Bombay town, Ahmedabad and Broach in Bombay Presidency; Amraoti, Akola and Balaghat in the Central Provinces; Cawnpore, Benares and Lucknow in the United Provinces; Assam as a whole shows high consumption, where the districts of Lakhimpur, Sibsagar, Nowgong, Darrang and Kamrup are noted for very high consumption of this drug. The highest consumption rate recorded in India is in the Sadiya Frontier Tract, where it is 94 seers per 10,000 of population per annum. The high figures are due to smoking of the drug, which necessitates much larger quantities of opium per head. On the other hand, there are extensive areas in all the provinces where consumption is very low, *i.e.*, even less than 12 lbs. or approximately 6 seers per 10,000 of population per annum, a standard laid down by the League of Nations for Medical and scientific needs of the people. Such areas are now on the increase. According to the survey by the author and his collaborators it is estimated that there are at least between one to five and a half million opium addicts in India, *i.e.*, approximately 0·5 to 1 per cent. of the total population.

(*ii*) *Opium smoking.*—It is not clear how this habit came into this country; probably it was introduced as a part of tobacco smoking by the Chinese or Mohammedan invaders but fortunately it never assumed such a menacing aspect as it did in China. Our present enquiries show that the habit of smoking opium in one form or other is met with on a small scale in many of the large towns in India. It would appear that the habit of smoking opium has considerably declined during the last thirty years. In most parts of India, therefore, this is a very uncommon method of consumption of opium at the present time. The only exceptions to this rule are Assam and the Central Provinces where opium smoking is almost as common as opium eating. According to a recent survey we have carried out (1938) it is estimated that at present there are between 62,000 to 83,200 opium smokers in India, out of which 25,000 are from Assam and 15,000 from the Central Provinces and Berar.

(*iii*) *Drinking of beverages made from poppy heads (unlanced capsules of* Papaver somniferum).—During the sixteenth, seventeenth and eighteenth centuries when the Moghuls were in power in India, the poppy capsules or 'post' capsules were extensively used to prepare a beverage which had soothing and euphoric effects. The use of poppy beverages has considerably decreased during the last three decades but still exists in a few localities in the Punjab and Rajputana. The effects are almost similar to that of opium eating. There are at present between four to five thousand poppy addicts in India.

(*iv*) *Addiction to opium alkaloids.*—Habitual use of morphine has considerably increased in India during recent years in

certain parts of Northern India. The addiction is usually met with in young persons between the ages of 20 to 25 years. The habit is generally started on account of the euphoric and aphrodisiac properties of the drug. In the beginning this alkaloid was taken almost exclusively by the mouth but recently the injection method has also come into vogue. The physical, mental and moral deterioration sets in much more rapidly than is the case with other forms of opium addiction. Addiction to other alkaloids of opium such as codeine and heroine, etc., is rare in this country.

(*v*) *Administration of opium to infants.*—The practice appears to have been started because of the drug's power of allaying diarrhœa and vomiting, relieving cough and pain, and producing sleep. The only areas where the custom is still extensively prevalent are certain parts of the Central Provinces and Berar and few other industrial areas all over the country. In Berar 75 per cent. of the infants are doped with opium. In the cotton-growing areas the children account for 40 per cent. of the total consumption of opium. The main reason for administering opium to the children are economic; the drug is given to keep the children quiet so as to allow the mother to carry out her work unhampered whether in the factory or in the field. The practice is begun during the first few weeks of the infant's life and is usually discontinued when the child attains the age of two or three years when it begins to play about and can live on ordinary food. The use of opium affects the child's health adversely and hinders its growth. The children receiving opium have an emaciated, unhealthy and toxæmic appearance. They are more liable to catch infections and to attack of epidemic diseases and the mortality rate among them is comparatively high.

Aetiology of Opium Addiction

Social and economic factors play an important part in starting and continuing this habit. The standard of social and hygienic conditions of the working classes in this country is very low. No healthy amusements are available and the workers living under such conditions are in search of some form of diversion which will enable them to forget at least for the time being, the monotony, hardships and worries of their daily existence. Their intellectual development is low, the housing conditions are primitive and overcrowding is general. The above conditions predispose them to the habit as it gives something which enables them to forget their worries. The main direct causes leading to the opium habit as studied in a series of 1,238 addicts were (1935):—(1) Association with other addicts which accounted for 50 per cent. of cases; (2) diseases or minor ailments for which no medical advice was sought, 33·3 per cent.; (3) hard work, worry or strain, 13·3 per cent.; (4) substitute for alcohol, 3·4 per cent.

Physical and Mental Effects

(*a*) *Opium eating.*—From an analytical study of 1,238 opium eaters the following conclusions are drawn: The habitual use of opium and in small doses may not produce marked physical or mental deterioration. Such addicts may keep fit, gain in weight and carry on their ordinary vocations of life efficiently for many years. With larger doses the gastro-intestinal tract becomes seriously disturbed, obstinate constipation alternating with Diarrhœa and loss of appetite supervenes. The addict shows signs of toxæmia, loss in weight, anæmia, sallow colour, etc., and even signs of cachexia. Opium habit is more liable to cause injury to the mental and moral faculties of persons with a nervous diathesis or with nervous irritability than to normal individuals. The common changes observed in such individuals are development of lazy habits, impairment of memory, slow cerebration, lack of self-confidence, selfishness and irritability of temper.

(*b*) *Opium smoking.*—From a careful study of 300 opium smokers the following conclusions are drawn: It has been observed that the Chinese and the Burmese smokers as a rule seem to suffer less than the Indian smokers. They are able as a rule to regulate their dose with precision and keep the daily consumption within limits which would not endanger their earning capacity by causing adverse effects upon their general health. The effects of general unhygienic environments, neglect of general health, lowered standard of living, and the use of a common smoking pipe are responsible for spreading such communicable diseases as syphilis, tuberculosis, pyorrhea alveolaris, amongst the habitues. Their role in causing incapacity amongst the habitues is nevertheless important. In the majority of smokers, the cost of the drug may be as much, or even more, than their earnings.

In order to make both ends meet the habitue tries to stimulate his physical energies by further increasing the dose so as to perform more work which further undermines his health and gradually decreases his working capacity. Eventually there is a complete loss of earning capacity and he is useless to himself and to society.

The confirmed opium smokers as a rule always show marked physical deterioration. The excessive smokers are thin, emaciated persons with sallow or muddy complexion, and dull and sunken eyes. The throat is often bad and constantly subject to attack of tonsilitis, pharyngitis and chronic bronchitis. The appetite decreases and may be lost, the food is not properly assimilated. When the drug has been abused for a long time the sexual impulse is very often deficient and wanting.

Prolonged and excessive smoking produces a lethargic state of mind, dullening of the mental processes, gradual loss of will power, neglect of work, subordination of every interest to the craving. Opium becomes the main object in life.

Biochemical studies.—Biophysical and biochemical properties of the blood serum were studied in opium addicts, when under the effect of opium and during the period of abstinence. The work on the physical properties of the sera of opium addicts shows that the blood of opium addicts becomes hydræmic. During the withdrawal period the hydræmia disappears and the blood becomes more concentrated and this is maintained both during and after the treatment. The lecithin and cholesterol contents of the blood were also determined simultaneously to see if these had any bearing. The results so far obtained indicate: (1) that in the majority of cases, the blood lecithin content is normal though in a few cases it is somewhat lower; (2) that there is an undoubted increase of lecithin in the blood, during the course of lecithin treatment; and (3) that the cholesterol figures are somewhat irregular and seem to bear no direct relation to the actual condition of the addict or to the lecithin contents.

Opium smoking and opium eating.—Smoking and eating of opium are different aspects of the same problem though the former is believed to be more harmful than the latter. The opium smoker needs very much larger quantities of opium to satisfy his cravings than the eater, but in spite of the smaller quantities of the morphine absorbed, the practice appears to be more harmful. The process of preparation is a long one and the actual smoking naturally takes longer time than swallowing of pills or a mixture of opium and water. For these reasons the smoking of opium is very often abandoned during later stages of addiction when the dose has become very large. The abstinence symptoms in case of smokers are more pronounced. The smoking habit more often is the outcome of the euphoric or pleasure-giving effects of the drug, while such causes of the disease as fatigue and old age frequently lead to the habit of eating opium. The increase in dosage in case of smokers is much more rapid, probably due to the fact that the actual amount of morphine absorbed into the system is smaller with each dose. The chemical changes which the constituents of opium undergo by drastic heating during the process of preparation for smoking must also be taken into consideration when comparing the effects. Although their exact nature is not known, it would appear that during the process of heating the effects of the drug become more potent. Also there is no doubt that the effects of non-alkaloidal constituents of the smoke, that is, other products of combustion, also play some part.

Treatment of Opium Addicts

Following the lead given by our biophysical and biochemical researches, a large amount of work has been done in connection with lecithin treatment of opium addicts in the Carmichael Hospital for Tropical Diseases. This treatment has been tried with success on several thousand opium addicts who were taking doses of opium ranging from 45 to 250 grains daily in Upper Assam Valley during the recent prohibition campaign against the drug by the Assam Government. Briefly, the procedure adopted is as follows: Opium is suddenly withdrawn and a dose of 1–3 grains of calomel is given at bed time which is followed by a dose of salts next morning. The last named is repeated every morning for the next few days to eliminate opium from the system and to help the liver to function. On the second day after withdrawal, lecithin is given in 20-grain doses thrice daily in the form of a pill. In a certain number of cases lecithin by mouth causes nausea, and in such cases,

the drug may be given in the form of a colloidal solution by injection, the usual dose being 2 c.c. of 1 per cent. solution twice daily. Experience has shown that lecithin when given by injection, acts better than when it is given by the mouth. Besides this, the amount required to produce the desired effect is comparatively small and consequently the cost of treatment is considerably reduced. During the period of abstinence the patient is encouraged to take plenty of fluids and glucose by the mouth as these greatly ameliorate the symptoms of withdrawal. He is also given 25 c.c. of 25 per cent. glucose along with 10 c.c. of 10 per cent. calcium gluconate by the intravenous route during the first five days of the treatment. Glucose by the intravenous route helps in the elimination of the opium alkaloids and stimulates the glycogenic function of the liver. It also serves as a ready food for the heart during the withdrawal period when all other food is generally refused. Calcium controls the muscular cramps which are commonly met with during the period of abstinence.

The duration of the treatment varies from seven to twelve days according to the dose, the duration of addiction and the age of the addict. Such untoward symptoms as low blood pressure and feeble pulse are combated by means of cardiac stimulants. Adrenaline given in doses of 5 to 10 minims checks the tendency to nausea and vomiting. Diarrhœa which is often a troublesome symptom is controlled by administration of such simple drugs as bismuth carbonate and aromatic chalk powder in 10 to 15 grain doses. The cramps and pains all over the body are treated by massage and administration of analgesics such as aspirin, phenacetine and veramon. In cases where the pains are very severe and unbearable, intramuscular injections of 2 c.c. of novalgin (Bayer) often give relief. Injections of 1/100 grain of hyoscine hydrobromide were tried but with little effect. Insomnia is a very troublesome symptom during the first few days of the withdrawal period and sometimes for several days after. Medinal in doses of 7½ grains is often effective in inducing three to five hours sleep. In cases where insomnia did not yield to barbiturates, alcoholic extract of *Rauwolfia serpentina* in doses of 10–20 minims was effective. Lecithin is usually stopped 4 to 5 days after withdrawal of the drug and the patient is put on a tonic mixture containing iron, arsenic and strychnine.

With this treatment it has been shown that the discomfort due to the withdrawal of the drug is reduced to the minimum and most of the patients gradually develop a dislike for the drug. The mental outlook of the addicts also shows a remarkable change. Addicts who were definitely apathetic and morose before the start of the treatment have been observed to become cheerful and energetic and gradually begin to take an intelligent interest in their surroundings. They become more sociable, docile and respectful and show inclination for work. A change in the physical appearance is also observed in some cases. This is probably due to the improvement in the general health and better digestion and inclination for food.

The morphine content of the urine of addicts was determined daily during different stages of treatment under hospital conditions. Morphine could be detected in decreasing amounts during 4–5 days after complete withdrawal of opium. It could not be detected in the urine after this period.

The total course of treatment varies from 7 to 12 days and during this period the change in the condition of the addict, is marvellous. The patients treated in the hospital are kept under further observation for a period varying from 4 to 12 weeks in order to rehabilitate and change and train them to the new environment and to watch for any relapse occurring. The period of rehabilitation and rebuilding of the personality of an addict may sometimes extend to 6 months.

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LETTERS TO THE EDITOR

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Effect of Crystal Orientation on the Raman Spectrum of Calcite

THE importance of studying the Raman effect in single crystals by adopting directional excitation has been stressed elsewhere. Much work on these lines has not yet been done. A recent paper by Nedungadi[1] contains all the necessary references to the earlier work and describes very fully the results obtained by him in the case of sodium nitrate. The author has also been engaged in studying the same phenomenon in the completely analogous case of calcite. The present note containing a preliminary account of the results obtained may be of interest as it closely follows Nedungadi's publication.

A one-inch cube of calcite cut in such a manner that the optic axis is parallel to one of its edges and having all its faces polished has been used in the present investigation. We shall designate the direction of incident light by OX, the direction of scattered light by OY and the three edges of the crystal are always along OX, OY and OZ. Twelve pictures, at the rate of four for each orientation of the optic axis, have been taken. The incident light is always linearly polarised and the scattered light is analysed with the help of a suitably oriented double-image prism. Visual estimates of the intensities are tabulated in Table I. This corresponds to Table III of Nedungadi's paper.

TABLE I

Direction of vibration of incident light along	Orientation of the optic axis along	Relative intensities of components of Raman lines					
		155		282		1084	
		OX	OZ	OX	OZ	OX	OZ
OZ	OX	40	0	100	0	0	70
OY	,,	40	0	100	0	0	100
OZ	OY	0	0	0	0	60	100
OY	,,	40	20	100	50	0	0
OZ	OZ	40	0	100	0	0	30
OY	,,	30	40	80	100	0	0

A very satisfactory agreement between the figures given in Table I and the results of Nedungadi is noticed. Amongst the important conclusions drawn by Nedungadi are the following which are also found to hold good in calcite. Both the low frequency lines disappear while the line at 1084 due to the total symmetric oscillation comes out strongly in the spectrum of the light scattered along the optic axis when the incident light vector lies in the plane of the carbonate ion (3rd row of Table I). On the other hand, the same low frequency lines come out strongly while the line at 1084 disappears in the spectrum of the light scattered along the optic axis when the incident light vector is perpendicular to the plane of the carbonate ion

(4th row of Table I). Besides such a reversal of intensities, it may be noted that the low frequency lines exhibit polarisation features which may be regarded as reciprocal in character to those exhibited by the total symmetric oscillation. The figures given in Table I clearly support these conclusions.

The author has not been able to record the other weaker lines due to internal oscillations in the case of calcite but a few remarks about these will not be out of place here. A detailed analysis of the normal oscillations[2] shows that these are degenerate and come under the same category as the low frequency lines. Their behaviour should accordingly be akin to the low frequency lines rather than to the total symmetric oscillation. Contrary to this expectation, Nedungadi concludes that all the internal oscillations behave in a like manner. His pictures however show that while this is true in the matter of polarisation, it is not so if we consider the aggregate intensities. It is clear from Figs. 3 *a* and *c* of his paper, which are intended to show this effect, that only the total symmetric oscillation becomes weak whereas the degenerate oscillation at 1385 as well as the low frequency lines remain quite intense. Figs. 6 *c* and *d* of Nedungadi taken together also show the similarity between the low frequency lines and the degenerate internal oscillations in the matter of aggregate intensities. A detailed account of the results along with a fuller discussion of the same will appear elsewhere in due course.

S. Bhagavantam.

Department of Physics,
Andhra University, Waltair,
October 13, 1939.

1 *Proc. Ind. Acad. Sci.*, 1939, **10**, 197.
2 *Ibid.*, 1939, **9**, 224.

Interaction of Atomic Energy Levels

The mutual influence of different elements on their spectra due to mixture has not yet been studied in a systematic way, although there are a large number of papers dealing with the influence of the rare gases on the spectra of several elements. The effect of introducing gases like hydrogen and nitrogen has also been studied to a certain extent. With the object of securing more extensive data regarding the changes produced in the spectra of elements by mixing them, we have first of all studied the effect of mixing zinc and mercury. The discharge from a 3 KVA, 2000 volt transformer was passed through a Pyrex tube containing mercury and zinc in two side limbs provided with tungsten electrodes and kept continuously evacuated by a Hyvac pump. The tube had a quartz window through which the discharge could be viewed end on. The light from the discharge was focussed on the slit of a concave grating of 10-foot focus in a Rowland mounting by means of quartz lenses. To distinguish between first and second order lines a thin glass plate was fixed across half the slit so that in the spectrogram the second order lines were shorter than the first order ones. Zinc of analytical reagent class was used as also another variety from De Haen which showed a slightly larger quantity of mercury as an impurity. Spectrograms were obtained with pure zinc and with a mixture of zinc and mercury so as to exhibit the same intensity in the case of the visible zinc triplet, and conclusions were based on a comparison of the intensities of other lines relative to these in the two spectrograms. A vacuum arc was produced in the same tube by connecting the two side limbs to 110 volts D.C. and having a third electrode which served to start the arc in the zinc vapour by means of a small induction coil connected to it and to one of the other electrodes. The spectrum of the arc was found to be almost identical with that of the discharge, except that the arc was much brighter. The spectra were photographed on Ilford hypersensitive panchromatic films and second order lines in the case of the discharge appeared with sufficient intensity after exposures of about an hour. A discharge through $HgCl_2$ vapour had previously been studied and the relative intensities of the mercury lines in the mixture were compared with the relative

intensities of the same lines in the $HgCl_2$ film. The following are the main results obtained:

1. The lines 3072 ($4\ ^3P_2 - 6\ ^3S_1$), 3036 ($4\ ^3P_1 - 6\ ^3S_1$) and 3018 ($4\ ^3P_0 - 6\ ^3S_1$) of zinc were very weak in both the arc and the discharge as compared with the resonance line

FIG. 1

3076 ($4\ ^1S_0 - 4\ ^3P_1$), whereas in the spectrogram given in Fowler's Report 3072 is brighter than 3076. This was true both in pure zinc and in the mixture. The intensities of these lines given by Hetzler, Boreman and Burns[1] show that this peculiarity is characteristic of the vacuum arc itself.

2. In the discharge through pure zinc 3076 was weaker than 3345 ($4\ ^3P_2 - 4\ ^3D_{2,3}$) and 3302 ($4\ ^3P_1 - 4\ ^3D_2$), but in the mixture it was stronger. Hetzler, Boreman and Burns who used an arc in vacuum between brass electrodes find 3076 weaker than 3345 and 3302. We find that 3076 brightens considerably with even small amounts of mercury, and possibly also with other impurities.

3. The zinc lines 2464 ($4\ ^3P_2 - 8\ ^3D_3$), 2480 ($4\ ^3P_0 - 7\ ^3D_1$), 2492 ($4\ ^3P_1 - 7\ ^3D_2$) and 2516 ($4\ ^3P_2 - 7\ ^3D_3$) decrease considerably in intensity in the mixture as compared with pure zinc. 2609 ($4\ ^3P_2 - 6\ ^3D_3$) and 2671 ($4\ ^3P_0 - 7\ ^3S_1$) also decrease in brightness to about a similar extent. A smaller decrease in intensity occurs in the case of 2568 ($4\ ^3P_2 - 8\ ^3S_1$), 2570 ($4\ ^3P_0 - 6\ ^3D_1$), 2583 ($4\ ^3P_1 - 6\ ^3D_2$), 2684 ($4\ ^3P_1 - 7\ ^3S_1$) and 2712 ($4\ ^3P_2 - 7\ ^3S_1$). 5182 ($4\ ^1P_1 - 6\ ^1S_0$) remains unaffected.

4. The mercury lines 2753 ($6\ ^3P_0 - 8\ ^3S_1$), 2894 ($6\ ^3P_1 - 8\ ^3S_1$) and 3342 ($6\ ^3P_2 - 8\ ^3S_1$) showed a definite increase in intensity as compared with the same lines produced by the discharge through $HgCl_2$, while 3663 ($6\ ^3P_2 - 6\ ^1D_2$ and $6\ ^3P_2 - 6\ ^3D_1$), 3655 ($6\ ^3P_2 - 6\ ^3D_2$) and 3650 ($6\ ^3P_2 - 6\ ^3D_3$) showed only a slight increase. 3132 ($6\ ^3P_1 - 6\ ^1D_2$ and $6\ ^3P_1 - 6\ ^3D_1$) and 3126 ($6\ ^3P_1 - 6\ ^3D_2$) seemed to be unaffected.

5. The only spark line of zinc, 2558 ($4\ ^2P_{3/2} - 5\ ^2S_{1/2}$), and of mercury, 3984 ($5d^{9}6s^2\ ^2D_{3/2} - 5d^{10}6p\ ^2P^0_{3/2}$) occurring in the discharge used, disappeared in the mixture.

The brightening of 3076 must be due to collisions of the second kind between mercury atoms in the $6\ ^3P_1$ state (energy 4·86 volts) and normal zinc atoms. According to Larché[2] the optimum excitation potential of 3076 is 4·9 volts. This explanation is also in accord with the fact that the spectrum of zinc given by Lord Rayleigh,[3] who distilled zinc vapour into a cadmium arc, shows 3076 weaker than 3072 itself. The energy of the $5\ ^3P_1$ state in cadmium is only 3·78 volts.

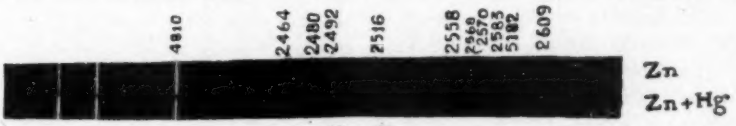


FIG. 2

The weakening of 2464, 2480, 2492 and 2516 must be due to the impoverishment of the $8\ ^3D$ and $7\ ^3D$ zinc atoms (energy 9·06 and 8·96 volts by interaction with mercury atoms in the $8\ ^3S_1$ state (energy 9·12 volts) since 2753, 2894 and 3342 of mercury show

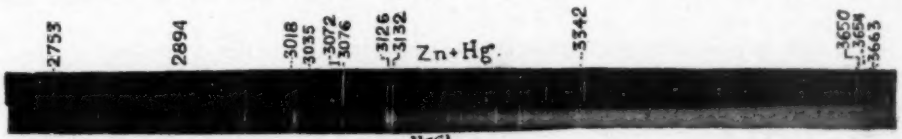


FIG. 3

an increase in intensity. The fact that the 6 ^{3}D states of mercury (energy 8·80 volts) do not show any marked enrichment at the expense of the 6 ^{3}D states of zinc (energy 8·79 volts) shows that such an interaction does not depend merely on the nearness of their energies. We may surmise that electrons first take up energy from the 8 ^{3}D and 7 ^{3}D zinc atoms and then enrich the 8 $^3S_1$ mercury states.

The work is proceeding; further details will be published elsewhere.

T. S. Subbaraya.
K. Seshadri.
N. A. Narayana Rao.

Department of Physics,
Central College, Bangalore,
October 26, 1939.

[1] *Phys. Rev.*, 1935, **48**, 656.
[2] *Zeit. f. Phys.*, 1931, **67**, 440.
[3] *Proc. Roy. Soc.*, (A), 1926, **112**, 14.

Sound Velocity and Inter-Molecular Forces

In recent years the velocity of sound has been determined with precision in a large number of liquids using ultrasonic waves.[1] The velocity of sound in a liquid is determined by the molecular arrangement in the liquids and the nature of the inter-molecular forces. It is found that in general the velocity of sound decreases with rise in temperature. A study of these shows that the ratio of the relative temperature coefficient of sound velocity to the coefficient of molar volume expansion is constant for a number of non-associated liquids. The mean value for the constant is found to be $-3{\cdot}03$. Thus

$$\frac{\frac{1}{v}\frac{dv}{dt}}{\frac{1}{V}\frac{dV}{dt}} = -3{\cdot}03,$$

where v is the velocity of sound in the liquid at temperature t and V the molar volume of the liquid. On integrating the above expression

$$vV^{3\cdot03} = \text{constant}$$
$$v^{0\cdot33}V = \text{constant}.$$

Table I gives the values of the velocity of sound and density at various temperatures. The molecular volume V multiplied by $v^{0.33}$ is found to be a constant over the entire temperature range for which values are available. In Table I values for only two liquids are given but the relation holds good for a number of other liquids like octane, heptane, chloroform and carbon tetrachloride.

Table II gives the values of the constant $R = v^{0.33}\,V$ for a number of liquids and also the molecular critical volume V_c. It is found that the ratio of the constant R to the molecular critical volume V_c of a given compound has an almost constant value of 3·53 for all substances.

Since the molecular volume is proportional to the cube of the inter-molecular distance it follows from $R = v^{0.33}\,V$ that the velocity of sound in a liquid varies inversely as the ninth

Table I

Benzene				*Toluene*			
Temperature	Velocity (m./s)	Density	$v^{0.33}V = R$	Temperature	Velocity (m./s)	Density	$v^{0.33}V = R$
10	1375	·8896	951	0	1414	·8848	1141
20	1324	·8790	951·5	10	1370·5	·8752	1140
30	1278	·8684	952·1	20	1327·5	·8657	1140
40	1231	·8576	953	30	1284·5	·8563	1141
50	1184	·8467	951·9	40	1242·0	·8470	1141
..	..	..	..	50	1199	·8378	1140

TABLE II

Substances	Value of R	Molecular critical volume V_c	$\frac{R}{V_c}$
Benzene	951·9	256·1	3·71
Octane	1681	487·6	3·44
Carbon tetrachloride..	924·1	276·1	3·35
Heptane	1499	427·1	3·51
Toluene	1140·5	315·4	3·61
Chlorobenzene ..	1179	307·8	3·51
Propyl acetate ..	1191	345·3	3·45
Ethyl propionate ..	1192	344·3	3·46

power of the distance between the molecules. Although the nature of the inter-molecular forces in a liquid are complex, it is convenient to assume the inter-molecular potential energy between two molecules to be given by

$$E = \frac{\lambda}{r^m} - \frac{\mu}{r^n}$$

where $\frac{\lambda}{r^m}$ is the term arising due to repulsive forces which is very small and $\frac{\mu}{r^n}$ is the term arising due to Vander-Waals attractive forces. Various estimates have been made of the values of m and n. Edser[2] finds a value for $n = 8$, while Wheeler[3] gives a value for $n = 10$. It is interesting to find that the present value of $n = 9$ found from a study of the sound velocities is therefore in conformity with the previous values. It is also found that in any homologous series the constant R increases with the number of CH_2 groups, i.e., by equal increments. The relation between the constant R and chemical constitution and other details will be published elsewhere.

M. RAMA RAO.

Department of Physics,
University of Mysore, Bangalore,
November 4, 1939.

[1] Bergman, *Ultra Schall*, 1937.
[2] Edser, *Fourth Report on Progress of Colloid Chemistry*, 1922.
[3] Wheeler, *Ind. Jour. Phys.*, 1933, **8**, 523.

The Root Knot Disease of Cotton

NEMATODE (eelworms) had been reported by Milne (1913) and Likhite (1934) on roots of cotton plants affected by the root rot disease. Usually they are found in the decaying shreds of root bark at an advanced stage of the disease. During the investigation of the root rot disease of cotton in the Punjab, nematodes were observed even on roots of apparently healthy plants. Recently the examination of roots of cotton plants of *Gossypium indicum* var. *Mollisoni* in some fields not affected by the root rot disease was undertaken. In some cases, the tap-root was found to bear swollen gall-like structures. The swellings were formed also on lateral root-lets. The examination of the interior of these knots showed presence of many slender eelworms. The galls have been found on the side of tap-root and also on its tip. In the latter case further growth of the tap-root is stopped. A similar disease is present almost in every State in the Cotton Belt of the United States of America, and is caused by the nematode *Heterodera marioni*.

The root knot disease has not been reported from any part of India so far. The incidence of this disease varies in different fields. It has been observed at Lyallpur, Sargodha and Khanewal. A survey of the cotton fields is required to determine the occurrence and incidence of the disease. The diseased material has been sent to Dr. Shirlaw and Dr. Thapar for identification of the nematodes.

Most of the plants affected by the root knot disease appear to be almost normal. But in the case of heavy infestation the colour of the leaves of the plants turns pale and the plants remain stunted.

In addition to cotton, eelworms have been found in lesions on the roots of various crops, i.e., Mash (*Phaseolus radiatus*, Linn.), Guara. (*Cymopsis psoralioides*), Groundnut (*Arachis hypogea*) and on weeds, *e.g.*, *Trinanthema* and *Heliotropium supinum*.

Roots bearing (*a*) nematode lesions on sides — Roots with (*b*) nematode knots at the tips

Fig. 1 shows the root systems of healthy and root knot affected plants.

JAI CHAND LUTHRA.
R. S. VASUDEVA.

Agricultural College and Research Institute,
Lyallpur (Punjab, India),
October 31, 1939.

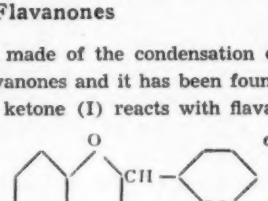
Milne, D., "Report of the Operations of the Department of Agriculture, Punjab," 1913.

Likhite, V. N., and Kulkarni, V. G., *Curr. Sci.*, 1934, 3, 252.

Condensation of Chalkones with Flavanones

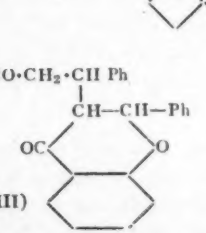
A STUDY has been made of the condensation of chalkones with flavanones and it has been found that phenyl styryl ketone (I) reacts with flavanone (II) in presence of 30% NaOH, to form (III). A number of chalkones and flavanones have thus been condensed, in presence of alkali or sodamide or pulverisodium (in ether or toluene), the last two being particularly effective.

Ph·CO·CH=CO·Ph
(I)



(II)

Ph·CO·CH₂·CH Ph



(III)

B. N. KAPLASH.
R. C. SHAH.
T. S. WHEELER.

Chemical Laboratories,
Royal Institute of Science,
Bombay,
State Laboratory, Dublin,
September 4, 1939.

Fossil Algæ in the Eocene Beds of the Salt Range

THE object of this note is to report the discovery of fossil algæ in some of the limestones from the Eocene of the Salt Range (Fig. 1). A general examination of this material shows that this algal flora is quite rich and varied—the Dasycladaceæ being the most prominent group. Side by side with genera like *Dissocladella*, *Acicularia* and *Neomeris*, which are known to commonly occur in rocks of Eocene age, it is most interesting to find in these rocks forms like *Oligoporella* and *Diplopora* which are elsewhere unknown in beds younger than the Trias. A detailed study, which is under progress, of

FIG. 1
Section of Khairabad limestone showing fossil algæ. × 17

this rich algal flora promises to be of great interest, both from the stratigraphical and the palæobotanical points of view.

We are deeply indebted to the authorities of the Burmah Oil Company Ltd., for letting us have samples of these limestones for study and for permitting us to publish these results.

L. Rama Rao.
K. Sripada Rao.

University of Mysore,
Department of Geology,
Central College,
Bangalore,
November 9, 1939.

Effect of Anti-oxidants on the Stability of Vitamin-A in Ghee exposed to Sunlight

The action of light, particularly ultra-violet rays, on butterfat (ghee) has been studied by several workers. Banerjee and Dastur[1] have shown that the destruction of vitamin-A in ghee when exposed to sunlight is considerable, especially when ghee is exposed in thin layers to direct sunlight. They have also shown that when the ultraviolet and heat rays are cut off the extent of vitamin-A destruction is somewhat reduced. This, and the researches of various workers on pro- and anti-oxidant properties of various substances (Olcott,[2] Mattill,[3] Lea,[4] and others), led us to study the effect of some of the anti-oxidants on the vitamin-A potency of ghee. Hydroquinone, sodium citrate and sodium tartrate were found to retard the rate of auto-oxidation in ghee, hydroquinone being the most effective anti-oxidant. It was considered probable that these anti-oxidants might also serve to minimise the detrimental effect of light on the vitamin potency of ghee.

Accordingly, an experiment was conducted under controlled conditions on the same lines as those adopted by Banerjee and Dastur (*loc. cit.*). All exposures were performed between 11 a.m. and 1 p.m. so as to allow vertical rays of the sun to fall directly on the materials. The layers of ghee were of 1–2 mm. thickness. Hydroquinone was added in amounts equal to 0·03 per cent. of the ghee (the quantity specified by the League of Nations' Health Organisation). Saturated solutions of sodium citrate and sodium tartrate (to which no objection can be raised) were added in quantities to make up 0·2 per cent. in the ghee. Vitamin-A determinations were made colorimetrically using the B.D.H. Lovibond tintometer and expressed as Blue Values in Lovibond Units per gram of ghee.

Cow and Buffalo ghees (vitamin-A content 17·4 and 15·4 B.V. respectively) were exposed to direct sunlight for 10 minutes with and without the anti-oxidants and their vitamin contents determined. The vitamin (estimated on 0·2 ml. fraction of unsaponifiable matter) was found to be absent in all the samples.

The experiment was repeated with the time of exposure shortened to 2 minutes. In this experiment also the almost total destruction of the vitamin was observed. Even with 1 ml. fraction of unsaponifiable extract, only a trace of blue colour was observed.

The results indicate that the presence of any of these anti-oxidants does not retard or minimise the destructive action of light on the vitamin content of ghee. The identical results obtained with Cow and Buffalo ghees when exposed to sunlight indicate that the natural colouring matter, *carotene*, which is present in larger amounts in Cow ghee, appears to have no protective action against the destructive effect of light on the vitamin-A.

It is, therefore, concluded that in order to preserve the nutritive growth-promoting factor of ghee, great care should be taken to avoid unnecessary exposure to sunlight.

N. S. Doctor.
B. N. Banerjee.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 9, 1939.

[1] Banerjee and Dastur, *Agric. & Livestock in India*, 1936, **6**, 433.
[2] Olcott, *J. Amer. Chem. Soc.*, 1934, **56**, 2492.
[3] Mattill, *J. Biol. Chem.*, 1931, **90**, 141.
[4] Lea, *Rept. Food Investigation Board* (Brit.), 1934, p. 38.

REVIEWS

Fabre and Mathematics and Other Essays. By L. G. Simons. (*Scripta Mathematica*, New York), 1939. Pp. 101. Price $1·00.

This small volume by Prof. Simons consists of a collection of four essays which are of a biographical and historical interest. The first two essays give an account of the keen interest in mathematics shown by the eminent entomologist, Henri Fabre, and by the great German savant, Alexander von Humboldt. The author's aim in presenting this account is to record the appreciation of mathematics by men in other fields. Prof. Simons has produced ample evidence to show the influence of an earlier mathematical training on Fabre's entomological work, and the extent to which he employed the mathematical concepts for the explanation of phenomena in the insect world. This has been acknowledged enthusiastically by the scientist himself.

Prof. Simons shows clearly in his second essay that Humboldt had penetrated far enough into the field of Mathematics to express an admiration for its methods. A detailed account is given of Humboldt's correspondence, extended over forty-eight years with C. F. Gauss. He describes also Humboldt's researches into the history of mathematical numeration and notation of primitive tribes and early peoples, which were made by Humboldt in his extensive travels. An analysis is also given of Humboldt's lifework, "Cosmos", which reveals the extent of Humboldt's knowledge of the history of mathematics, and his profound appreciation of the part played by mathematics in all the life of the world.

The third essay deals with the influence of French mathematicians upon the teaching of mathematics in American colleges. It is remarked that when the *American Academy of Arts and Sciences* was founded in 1780, its founders placed on record the statement that it was their intention "To give it the air of France rather than that of England and to follow the *Royal Academy* rather than the *Royal Society*". *The Normal School* and the *United States Military Academy* were founded on the model of the *Ecole Normale* and the *Ecole Polytechnique*. The works and text-books of Lagrange, Laplace, Legendre, Monge, Bourdon, Biot, Lacroix and others were translated and extensively used upto the 19th century. France can thus justly lay claim to the accomplishment of a revolution in all branches of mathematics in America as well as in other countries.

In his fourth essay Prof. Simons has given the story of Geometry as studied in several American colleges, such as those at Harvard, Yale, Columbia and Pennsylvania. He records Thomas Brattle's evidence to show that Euclid was no part of the course at Harvard at the end of 17th century. He records further that among the mathematical problems required by the Department of Mathematics for graduation towards the close of the 18th century, not one demonstration of a geometrical theorem is found, although a knowledge of geometrical truths is required for the solution of many of the problems set. He gives the record of a public examination conducted in 1786, "in which each student was required to draw a number out of a box and to demonstrate without further assistance the problem or theorem in Euclid to which it referred".

The book can heartily be recommended to the mathematician and the layman alike. It would exercise a salutary effect on the appreciation of mathematics as a part of the educational discipline for all students through the secondary school grade—a fact to be emphasised in an age when there is so much misdirected clamour for a so-called realistic and vocational education.

There is a printing mistake on page 73, last but one line, where Greenwood's first year of Professorship at Harvard is wrongly given as 1772 instead of 1728.

M. R. Siddiqi.

Rayons Cosmiques. III. By J. Clay, P. M. S. Blackett and G. Lemaitre. (Herman et Cie, 6 Rue de la Sorbonne, Paris). Papers read in October 1937 at The Congrés du Palais de la Découverte, Paris. Pp. 37. Price 10 *fr.*

In the first section of this report J. Clay of the Natureskundig Laboratorium, Amsterdam, discusses the very complicated phenomena of "penetration and degradation

of cosmic rays in matter". After a very brief summary of current ideas on the subject the writer describes and gives the results of a series of ingenious experiments designed to throw light on the complicated processes which cause the discharge of ionization chambers. It is shown that the "radiation complex" which ionizes the gas in a chamber, consists of hard cosmic rays, soft cosmic rays, photons produced in the gas and in the walls of the chamber and by "artificial radio-activity" induced chiefly in the walls of the chamber by cosmic rays. Of course, many of these rays, both hard and soft, are secondaries which in turn produce tertiaries and so on until the original energy is dissipated as heat chiefly by a process of ionization in absorbing matter.

In the second part of the report P. M. S. Blackett of Cambridge discusses the behaviour of cosmic rays in the atmosphere and especially the nature of the hard component which constitutes about 80% of the cosmic radiation found at sea level. This section presents clearly the background for the subsequent discovery of the mesotron (heavy electron), and helps one to realize how complex and difficult is the still unsolved problem of the hard component of cosmic radiation. The section ends with comments by Pierre Auger and by Homi J. Bhabha, who have made especially important contributions to cosmic ray theory.

The third section is a discussion of the behaviour of cosmic rays in the earth's magnetic field and of their intensity variations. The subject is introduced by G. Lemaitre of Louvain, who gives a very brief resume of current ideas. E. M. Bruins of Amsterdam presents results of extensive measurements of cosmic ray intensities at various latitudes and longitudes and discusses intensity anomalies due to the lack of uniformity of the earth's magnetic field.

J. Barnothy and Mlle. Forro present evidence obtained by means of Geiger-Muller counters during a period of three years indicating a periodic variation of cosmic ray intensity with siderial time. The amplitude of the variation reported by these workers is much larger than that predicted by Compton and Getting in 1936. In explanation of measurements made with counters in deep mines they suggest that cosmic ray showers found at great depths under water or rock are caused by neutrinos.

It is interesting to note that the nature of the very penetrating portion of cosmic rays is still a mystery in spite of much recent work. J. M. BENADE.

Réunion Internationale de Physique-Chimie-Biologie. Congrès du Palais de la Découverte, Paris, October 1937. II Physique Nucléaire. (*Actualités Scientifiques et Industrielles* No. 719) (Hermann et Cie, Paris), 1938. Pp. 54. Price 15 *fr.*

This is the second part of the Report of the discussions held in connection with the International Congress at the Palace of Discovery in 1937. It deals with Nuclear Physics and contains papers by Bohr (introductory), Scherrer (the reaction $D + D = {}^3He + n$), Cockcroft (transmutation of elements), and Bothe (spectroscopy of nuclei). Short summaries of remarks made by others who took part in the discussion are also included. The brochure gives a succinct account of the new point of view introduced by Bohr in nuclear theory, and the most important experimental methods and the chief results of nuclear research. Seeing that the contributors are the leading authorities in the several lines of enquiry here brought before the ken of the reader, it would be superfluous to add that a just and illuminating statement of the present position of theory and experiment in the field of nuclear physics is here presented. T. S. S.

Atomic Structure. By Leonard B. Loeb. (John Wiley & Sons, Inc., U.S.A.; Chapman & Hall, Ltd., London), 1938. Pp. xvi + 446. Price 22*sh.* 6*d.*

This is an introductory text-book on Atomic Structure. Written in the clear style characteristic of the author it embodies the fundamentals of atomic physics. The order of presentation follows the historical development of the subject. Both the lecturer in atomic physics and the student must bear in mind the following statement of the author in the Introduction. "Physicists live in a mechanical world and their physical thinking is in terms of their experience and of the Newtonian physics which they first learned... In fact with the abstract nature of wave mechanics it would be impossible to introduce students to the subject by such means". We heartily endorse the view expressed in these sentences and the lecturer introducing the subject of atomic physics to

his students must remember the fact that wave mechanics can be grasped by the beginner only after he has had a grounding in the subject starting from Newtonian mechanics.

The text is divided into four parts and contains twenty-one chapters in all. The first chapter is a comprehensive summary of the growth on classical lines of our knowledge of the electron, and contains concise but clear accounts of the experimental investigations on e/m, e and m of the electron together with the relativity correction for its mass and other related topics. Chapter two treats of Positive Rays, Aston's mass spectrograph and Radio-activity. Chapter three is concerned with X-Rays. The rest of Part I treats of the atomic nucleus including the Gamow Nuclear Model. Part II treats of the development of spectral theory based on Rutherford's nuclear atom and beginning with Bohr's explanation of the atomic spectrum of hydrogen. Part III deals with the Electrical Properties of Atoms and Molecules and embodies a number of related subjects among others, ionisation potentials, energy level diagrams, photoelectric phenomena, atomic and molecular structure and band spectra. In Part IV are treated the kinetic theory of gases, the electron theory of metals and the wave mechanical concept of the metallic state. Throughout the author has treated the various matters connected with atomic structure with remarkable clearness and accuracy. The beginner in this subject cannot get a more entertaining and instructive book dealing with the fascinating subject of atomic physics. One who has mastered this book will be in a position to read with benefit more advanced books on atomic theory. We have no hesitation in recommending the book to first and second year students of Indian Universities taking both Pass and Honours courses. B. V.

Theory and Design of Valve Oscillators for Radio and Other Frequencies. By H. A. Thomas. (Chapman & Hall, Ltd., London), 1939. Pp. 292, figs. 103. Price 18*sh.*

This book forms volume seven of 'A Series of Monographs on Electrical Engineering' under the editorship of Mr. H. P. Young. Prof. Appleton has aptly remarked in his Foreword to this book: 'Among the ever-increasing number of applications of thermionic valve, there can surely be none more striking or of greater consequence than its use as a generator of sustained electrical oscillations.' The present volume from the pen of Dr. Thomas, whose pioneering work in this field has won him world-wide recognition, is very welcome.

As the title suggests, the treatment is confined to the generation of self-oscillations by a thermionic valve and excludes crystal controlled oscillators, etc. The author clearly points out in his Preface that since a vast amount of easily available literature on quartz crystals exists, such material has been excluded from his treatment.

The book is meant for the 'advanced student and technician' and assumes a good knowledge of A.C. theory and mathematics, including differential equations.

The field of use of the self-oscillator is very large indeed and Dr. Thomas has not spared to give a thorough treatment. The book is divided into eleven chapters. After the first few chapters on the fundamental principles of self-oscillations and the conditions for maintaining them, a critical survey of the various factors affecting the change in frequency are considered; finally, the different methods of frequency stabilisation are presented.

The chief problems in the design of any oscillator are:—

(1) the magnitude and constancy of amplitude;
(2) the harmonics content in the oscillatory current;
(3) the efficiency of conversion;
(4) the value and stability of the frequency of oscillation.

These the author has discussed in great detail. A clear graphical analysis of the effects resulting from a variation of any one of the circuit parameters is given. The qualitative treatment gives a clear insight into and prepares the ground for the study of frequency stability in later chapters.

The range of oscillators described is indeed wide: starting from the simple dynatron, various retroactive types are deduced, by omitting one or more circuit elements. Also relaxation oscillations (including those of Van der Pol's type) have been considered. The analytical method, due to Prof. Moullin, for the rough estimation of the harmonic content is explained, followed by an example.

Although the book is well written on the whole, it is a little disappointing to note that

some important types of oscillators, *e.g.*, the push-pull, magnetron and heterodyne types, have not been dealt with in the text.

Chapters 6 and 7 dealing with the effects of temperature on 'L' and 'C', contain much valuable information drawn upon the author's personal researches. The last three chapters of the book are extremely practical and useful.

The extensive bibliography at the end of the book containing 83 references should prove invaluable. The general get-up of the book is good and the price reasonable.

Finally, the reviewer considers he cannot do better than quote Prof. Appleton's words in the latter's Preface to this book: To any one likely to employ a valve-oscillator for any purpose whatever, this can be unhesitatingly recommended as a friendly and trustworthy guide. V. V. L. R.

A Practical Manual of Chemical Engineering. By Harold Tongue. (Chapman & Hall, Ltd., London), 1939. Pp. xv + 560. Price 36*sh*.

Like other subjects in the hinterland between two or more sciences, Chemical Engineering is so wide in its scope and requires for its study a basis of so many sciences that any one who sets out to write a book on Chemical Engineering would be faced initially with difficulties regarding the limits of his task. While a knowledge of Chemistry, Physics, Mathematics and the several branches of engineering are necessary for the chemical engineer, and their immediate application to large-scale chemical processes must find a place in a text-book on the subject, an attempt to be really comprehensive in these directions would mean the compilation of a very large treatise. Restriction to the unit operations of which the chemical engineer has perforce to have detailed knowledge is, therefore, usual. Chemical Engineering treatises now available are mostly of American origin and are therefore concerned with American practice; a book representing British practice and describing British chemical plant is of special interest.

The book under review consists of two sections. The first six chapters deal with materials of construction and design of pressure plant, the latter being also the subject of a separate and well-known volume by the same author. The first section is packed with data of great practical value to the chemical engineering student and to the professional chemical engineer. The second half of the book, consisting of ten chapters, deals with some of the important unit operations. The chapters on heat transfer, evaporation, steam plant, drying, and distillation deserve special commendation for clarity and thoroughness.

The title is not altogether appropriate, as it might lead one to expect a laboratory manual with experimental suggestions and details, which may be used by the teacher for the conduct of practical classes. Such a practical handbook incidentally would be a very welcome reinforcement to the text-book resources of the teacher in Chemical Engineering.

The relative importance of the various branches of a subject must remain a matter of opinion, but the attention accorded to some of the topics in the present book is obviously disproportionate. "Filtration" has been confined to a description of filters, experimental methods, equations and their application in practice not finding a place. Super-centrifuges are barely mentioned. "Transportation of fluids" has received inadequate treatment, while other unit operations, such as size separation and crystallisation, have been omitted. Chapters I and VI might have been considerably abbreviated, and provision made for filling up the gaps to which reference has been made. The copious diagrams and tables are very valuable, but the illustrations in full-page plates are of doubtful utility in comparison with the cost.

Among the corrections of printing errors that may be made in a later edition are the replacement of "u" by "μ" (p. 329), "9" by "11" in the equation referred to in the second paragraph of p. 346, "separation" by "expression" in the last line but one on p. 435, and "vapour" by "liquid" in line 4 on p. 441. In the diagram on p. 432, the upper edge of the vapour nozzle should be higher than the top edge of the downtake pipe to the plate below. The illustration referred to in paragraph 4, p. 260, is missing. In equation (15), p. 344, "¼" should be taken outside brackets and applied to the whole fraction by which the figure 0·725 is multiplied. These defects and errors are, however, of a minor character. This contribution to the literature of Chemical Engineering is an extremely useful addition to a technological library. K. V. & J. G. K.

An Introduction to Genetics. By A. H. Sturtevant and G. W. Beadle. (W. B. Saunders Company, Philadelphia), 1939. Pp. 391, figs. 126. Price $3·25.

The authors of this text-book have both spent their lives in pioneer research on the frontiers of genetical exploration. The senior author was one of Prof. T. H. Morgan's original band of graduate students at Columbia in 1910, when Drosophila investigations were first begun. The junior author has already achieved an enviable international reputation. It is doubtful whether another pair of men could be found better equipped to expound the science of genetics or to discriminate what is of most value for an introductory course. In this book they have followed a particularly attractive and logical method of presentation. The cytological mechanisms and the genetical ratios are presented together, the former elucidating the latter.

That genetics is a science of ratios is emphasised and at the start the reason for the sex-ratio of 1:1 is demonstrated. From this it is logical to pass on to sex-linkage-autosomal inheritance and classical Mendelian ratios. For classes this arrangement permits an immediate application of the textual material in breeding studies with Drosophila. The phenomena of linkage and crossing-over are approached from results of actual experiments with two, and then three, gene pairs involved. This is clarified by excellent diagrams of meiosis in which four-strand crossing-over (chiasma formation in split chromosomes) is shown. Cross-over values lead to chromosome map-making, which is illustrated by *Drosophila melanogaster* and *Zea mays*. The rôle that abnormalities, such as attached X-chromosomes in Drosophila also translocations and inversions, have played in elucidating genetical principles is explained. The value of the now famous giant salivary glands for identifying chromosomal regions and for direct observation of inversions, duplications and deletions of segments is demonstrated by diagrams and micro-photographs. Clear explanations are given of other genetical phenomena which are frequently mystifying to the beginner, including: blanaced lethals, multiple-crossovers, ring formation and semi-sterility produced by reciprocal translocations, multiple alleles, position effects, non-disjunction and mutations.

In the last third of the book the authors deal in a masterly manner with matters of wide implication with respect to evolution. The most important of these are: the genetic basis of sex, selection in relation to continuous variation, practical breeding phenomena, polyploidy, the genic relationships in heterogeneous populations and between species. Two chapters of particular interest, which deal with the very latest research results, are those on "Extrachromosomal Inheritance and Maternal Influences" and "Genes and Phenotypes", in which problems of development are considered.

The authors have expressly refrained from including an extensive bibliography, but adequate references are provided in every chapter. Instructive sets of genetical problems are also given with each chapter. The book concludes with a brief, just historical summary.

The method used by the Drosophila school of designating wild type genes by a plus sign and the recessive alleles by the small initial letter of the name of the gene is followed. When discussing the hypotheses for blood group inheritance in man, the genes are denoted in the more usual manner, *i.e.*, 'A' for dominant and '*a*' for recessive. A foot-note on the latter method of writing allelomorphic pairs would be helpful to many readers. Those who have had no experience with Drosophila may well feel doubts as to human ability to distinguish between some of the eye colours shown in Plate I. This is purely a matter of training and can be done unfailingly by the "Drosophila people", even as a shepherd easily recognises each of his sheep.

This book can be confidently recommended, not only as a beginner's test, but to mature students whose genetical knowledge is rudimentary, or obsolete, or otherwise in need of refurbishing.

EILEEN W. ERLANSON MACFARLANE.

Bacteria in Relation to Milk Supply. By C. H. Chalmers. (Edward Arnold & Co., London), 1939. II Edition. Pp. 201. Price 6*sh*.

The fact that the second edition has been issued hardly four years after the publication of the first, shows the popularity with which Chalmer's book has been received. The book is divided into two parts loosely termed "Principles" and "Practical Applications" which are treated in the reverse order as in the first edition. The further sub-

division of the parts into chapters also has remained the same as in the first edition. The author has rewritten some portions in the first part on "Practical Applications" and has revised the sections on the methylene blue reduction test and the phosphatase test and also enlarged the section on sampling and thus brought the information up to date. Minute details are given on counting of bacteria, on milk smears, calculation of magnification on the microscope and measurement of bacteria. The nature and causes of abnormal conditions of milk such as bitterness, oiliness, sliminess, fishiness, caramel, phenol, alcohol and cardboard flavours of milk have also been properly dealt with. Methods have been indicated for testing additions of colouring matter and preservatives of milk. Illustrations of the different forms of bacteria and detailed descriptions of bacteria occurring in milk will prove useful to the students using this book. Methods for the detection of indol, phenol, acetylmethyl carbinol, etc., have been included and given in some detail.

Although the author has given references to easily accessible literature, especially about the new matter included in this edition, he has not mentioned the original sources of the material included in the book. This would have helped the readers a great deal in finding out and examining the original literature on dairy bacteriology whenever they felt inclined to do so, because although meant chiefly for the dairy bacteriologist engaged in testing milk for the milk industry, this book is likely to be used by students and teachers in dairy bacteriology; and to these latter class of persons, citations of original literature on the whole subject-matter of dairy bacteriology would have proved very useful indeed. N. V. J.

Qualitative Organic Chemistry. By Neil Campbell. (Macmillan & Co., Ltd., London), 1939. Pp. x + 213. Price 8*sh.* 6*d.*

The book is mainly divided into two parts.

Part A deals with the purification of organic compounds and with a scheme for their identification, which is essentially based on chemical properties. The theoretical basis underlying the practical methods has been emphasised by inclusion of a chapter on properties and reactions of the various types of organic compounds. The author has rightly emphasised the preparation of suitable derivatives as a very essential part of organic identification. The chapter on the preparation of derivatives, which is a valuable feature of the book, includes the description and use of many of the reagents recently introduced, especially by American workers. A number of colour reactions have also been included, and include among others important tests like the Ninhydrin test and Millon's test, which are not to be found in the more usual books on the subject.

Part B contains a chapter on nomenclature followed by classified tables of organic compounds in order of their melting points or boiling points.

The volume under review is a welcome addition to the existing books dealing with the qualitative analysis of organic compounds. Exhaustive references to standard books and original papers and the bibliography at the end, enhance the value of the publication. Although primarily intended for under-graduate students, for whom it is suitable, the book will be found equally useful by post-graduate research students in organic chemistry. R. C. SHAH.

Sammlung Göschen des Wissen der Welt, I. Symbiose der Tiere mit Pflanzlichen Mikro-Organismen. By Prof. Paul Buchner. Pp. 123. **II. Geschlecht und Geschlechtsbestimmung im Tier und Pflanzenreich.** 1939. Pp. 110.

The series is intended to give encyclopædic information on a large number of varied topics of interest to the public, each volume being written by a specialist on the subject. In the first number of the series, Professor Buchner gives a vivid account of symbiosis —an association of organisms for mutual benefit—a subject which at first sight does not appear to be so vast. The author, in these pages, has shown the extensive nature of the phenomenon and has dealt with the various types of bacterial, algal and fungal relationships. The localisation, spread and significance of the different associations have been discussed and a number of cases of insect and plant or bacterial associations are mentioned. The author also gives the experimental work on symbiosis and the information of this phenomenon in the economy of nature.

The volume, though small, is nicely printed, well bound and profusely illustrated. There are a number of diagrams illustrating

the author's own researches. Although the book is a concise epitome of all the facts on the subject, it can be used with profit even by advanced research workers. An exhaustive and up-to-date Bibliography is included at the end of the volume.

The second number *Geschlecht und Geschlechtsbestimmung im Tier und Pflanzenreich* is another excellent volume in the same series. Prof. Hartmann has described in this volume the various types of sexuality and discussed both the haploid and diploid types of chromosome divisions. He has also traced the evolution of sex and quoted cases of *Chlamydomonas, Actinophrys, Spirogyra, Chilodon,* certain Gregarines, *Dunaleilla, Ectocarpus* and a few other forms to illustrate and elucidate the various steps. The chapter on Sex-chromosomes is well planned and written and the experiments on intersexuality are adequately described. The value of sex hormones in the physiology of development is also discussed. In the last chapter the author gives a brief account of the entire problem of sex and the theories connected with it. The volume is well illustrated. G. S. T.

Manual of Practical Botany. By Jagjivan Singh and Bhagat Ram Vasisht. (Ram Lal Suri & Sons, Anarkali, Lahore), 1939. Pp. 350. Price Rs. 3–8.

This is a treatise on Practical Botany brought out by two teachers of the Government College, Lahore. While it is mainly intended for the Intermediate students, in the words of the authors "it is hoped that students of the degree classes will also find much useful material in this book".

The subject-matter covers in a comprehensive manner, almost all branches of Botany and we have no doubt that the degree candidates will find here and there something useful for themselves.

Though almost all branches of Botany have been treated, we feel that this has been done in the usual hackneyed way, so commonly found in elementary books, of treating these branches as separate water-tight compartments. One would have preferred a more natural and admittedly a more desirable approach, in the shape of bringing into prominence the correlation between form, structure and function, at least so far as the Angiosperms are concerned. Nowhere can this close relationship be brought out with better advantage than in a Treatise on Practical Botany. Apart from this, we feel that the Histology portion has not received adequate treatment. Topics like the primary meristem, the fundamental distinction between stem and root structures, the course of vascular strands in the monocot and dicot stems, some details about wood, including annual rings, are some of the items which one would have wished to see treated in some detail.

Similarly the foliar concept of the floral organs could have been brought out in an elementary form. Especially is a true concept of the carpel an important pre-requisite for a correct understanding of placentation, sutures and the like. Only then will an elementary student understand correctly an expression like a unilocular bicarpellary gynæceum.

These observations, however, do not detract from the value of the book which is a useful guide to those for whom it is primarily intended. The three appendices form a very useful adjunct, especially the one on the collection and preservation of plants. On the whole the book is a welcome addition to the literature in the field of Practical Botany in which it cannot be said that there are already a large number of publications.

T. S. RAGHAVAN.

Practical Botany. By S. Williams and G. Bond. (Edward Arnold & Co., London), 1939. Pp. 96. Price 5*sh.* 6*d.*

The Indian student of Botany is very often accused of his tendency to learn things by rote rather than by critical observation. In training his critical and accurate powers of observation, the practical side of Botany has an important role to play. From this point of view one is glad to find in modern times increasing importance being given in Indian Institutions, to practical Botany. To any teacher of Botany in an Indian University, it is a familiar thing that at the commencement of each practical class, the Demonstrator takes a good bit of the time in giving instructions and often in going briefly over the portions already dealt with in the Lecture class, and which the students have to do in the practical class. Of late, however, work sheets are being issued to the students in advance, and it is their duty to conform to the instructions contained therein. This system of work sheets has the decided advantage of making the students more self-reliant rather than depend for

everything upon the Demonstrator. This does not, however, mean that the work sheet can replace the Demonstrator; nor does it seek to do it. It serves to save time and forces the student to come prepared to the practical class, as otherwise he comes in the confidence that he can learn what to do, at the beginning of the class from the Demonstrator's lecture.

The present book is more or less a compilation of the work sheets issued by the authors to the First Year students of Botany of the University of Glasgow. It may at once be said that not only will our Intermediate students be greatly benefited by a study of the book, but the degree candidates also will find much useful information throughout.

The book is divided into two parts, the first dealing with the morphology and physiology of Angiosperms and the second, with the other groups of the vegetable kingdom. Of necessity the second part is limited in scope and extent. But there is enough material in it to be of use to our degree candidates. The chapters on Angiosperm stamens, carpels, seeds, etc., contain much useful information not commonly found in elementary text-books.

In the first part, the salient features of Angiosperm morphology are given and the physiology portion has rightly received more attention. Greater emphasis has been deservedly placed upon general principles rather than upon mere terminology. One does not see for instance, the long list of terms used in the description of leaf form, texture and the like. Instead, the principles on which the arrangement of the mechanical tissues in the various organs are based, have been elaborated. The chapters on Xerophytes and Hydrophytes serve as a useful introduction to the study of the general principles of ecology and ecological anatomy.

In short, the book besides containing much useful information, is bound to serve the main purpose that any good practical book on Botany should, of developing the powers of observation in the elementary student of Botany.

T. S. RAGHAVAN.

Hand-book of Mica. By Ramani Ranjan Chowdhury. (Thacker Spink & Co., Ltd., Calcutta), 1939. Pp. xvi + 332. Price Rs. 15.

Mica has a unique combination of several desirable physical characters which makes it an extremely valuable mineral in the electrical, radio, aeronautical and several other modern industries, and with the rapid growth of these industries the demand for this mineral will be continuously increasing. As a constituent of several rock types though mica is widely distributed in nature, the commercially valuable deposits of the mineral are, however, confined only to a few countries like India, South Africa and Soviet Russia. India has been one of the chief producers of mica, but wasteful and unscientific methods of exploitation, careless grading of dressed mica, want of an intimate knowledge of international markets and their actual requirements and several other similar causes threaten the rapid deterioration of the Indian mica industry. Consequently, it seems to be necessary to take early steps to provide the Indian mica miners and mine owners with the necessary information relating to the modern methods of scientific exploitation, mining and suitable preparation of the mineral to the market. Publications which give an authentic and comprehensive account on mica mining, dressing and preparation for market are very few and even these are not easily available to many of the mica miners. Consequently, Mr. Chowdhury's book, *Hand-book of Mica*, recently published, may be stated to supply this want and will be a welcome addition to the scant literature existing on the subject.

The *Hand-book of Mica*, containing some 330 pages, is a comprehensive treatise on the subject dealing with various aspects including the geology of the mica deposits, the physical and chemical properties of mica, its occurrence and distribution, methods of prospecting and mining, preparation of the mineral for market and grading, built-up mica, mica products and their utilisation in industries, international markets for mica, etc. The book is divided into six parts containing 18 chapters in all, and 5 appendices and numerous illustrations.

The first part deals with the general geological aspects of the mica deposits, and the physical characteristics and chemical composition of the several varieties of the mineral. The next part gives a detailed account of the modern methods of prospecting, development and mining of the mica deposits, including some useful hints for locating and following up the workable mica deposits in India. Chapter V of this

part, dealing with the problem of wastage in mica mining, gives an idea of the inevitable waste of mica during the course of mining and dressing, and the proportion of such wastage to saleable material as experienced in different countries. Part III, which forms a large section of the book, describes the mode of occurrence and the geographic distribution of mica in India and foreign countries and contains much useful information on the different Indian deposits including their description, mode of working, fluctuations in production and export and similar other particulars. In parts IV and V, the author treats at great length the commercial preparation of mica and mica products and their utilisation in industries, and also describes the standard gradings of mica, their testing and specification, the impurities and inclusions contained in mica, artificial substitutes for mica, and the possibilities of producing artificial and synthetic micas. The final part forms an interesting reading dealing with the technique of mica marketing, international mica trade and the present and future outlook of mica industry in India.

The irregular, superficial working of the mica deposits leading to the abandonment of richer portions deeper down; the primitive, unscientific, wasteful methods of mining still in adoption in several places in India and the careless grading of sheet mica in entire ignorance of market requirements, which all lead to the deterioration of the mica industry in India are clearly emphasised. The author offers several useful suggestions in the book to save the Indian mica industry from its periodical stagnation and to place it on a satisfactory and stable basis.

The book, on the whole, forms a valuable monograph on mica and is highly useful to all who are interested in the Mica Industry and more so to those who are connected with the Indian mica industry. The price of the book, however, seems to be rather high which may prevent its being within the reach of many.

B. RAMA RAO.

Indian Refractory Clays. By H. Crookshank, B.A., B.A.I. (*Bulletin No.* 14, Industrial Research Bureau). Pp. vii + 63. Price Re. 1–6–0.

This small book gives in a convenient form a concise account of the refractory clays in India. The introductory chapter among other things, gives the nature and chemical composition of refractory clays and the effects of admixed impurities such as iron, titanium, lime and magnesia, and alkalies on the refractory qualities of such clays. Chapters II, III and IV describe the mode of origin, physical and chemical properties, and special uses of the refractory clays as classified under three well-recognisable groups—Sedimentary refractory clays, Kaolins and Lithomarges. The gist of information contained in these chapters is as follows:—

The Sedimentary refractory clays are of widespread occurrence in India and though some of the deposits occurring in the Gondwana formations are extensively worked near Jubbulpur for making fire bricks, etc., the others have been hardly touched. This is due to many obstacles existing for starting refractory industries in other parts of India. These clays are, however, largely suitable for ceramic industries also.

Kaolin or China clay results from the decomposition of felspar in the granitic rocks. The China clays are of different grades and though all are highly refractory only the poorest and the cheapest are used for refractory materials. The best qualities are used in the textile industries and the second quality Indian kaolins are finding extensive use in paper manufacture. Although kaolin deposits are numerous and widespread in India, many of them are not being worked. This is not due to want of sufficient demand in India, but in many cases the washed material produced at present in India, is not of sufficiently good and uniform quality to displace the more reliable imported China clays. However, with improved methods of washing the local material has been able to displace, to a fairly large extent, the imported China clay used for purposes of paper manufacture. The China clay deposits of India are comparatively small and are widely scattered and this, when combined with the limited demand for kaolin in India and our failure to use the different grades of kaolin to the purposes to which they could be advantageously utilised, will easily explain why the development of the kaolin industry has been comparatively slow.

Lithomarge is the decayed clayey material underlying the laterite and it is not of a uniform composition. It is not of any great economic use.

Chapter V gives the geographical distribution of all the known deposits of refractory clays in India arranged in a specified way according to Provinces and States in alphabetical order. Each of these deposits has a brief useful note containing all the information available on it. The information on the refractory clay deposits of Mysore, however, as extracted from older publications, is incomplete and not up-to-date.

There are 8 tables containing additional useful information, such as the analyses of Indian and foreign fire bricks, analyses of Indian refractory clays of some 89 samples from different parts; analyses of standard foreign refractory clays and similar other particulars. There is also a map of India showing the deposits of the three types of refractory clays described in the book.

It is needless to say that this handy reference book will be highly useful to those who are interested in refractory, ceramic and other allied industries in India.

B. RAMA RAO.

The Thyroid Gland and Its Disorders

1938 Transactions of the Third International Goiter Conference and the American Association for the Study of Goiter. (J. C. Hamilton, Goiter Publications, Concord Building, Portland, Oregon), 1939. Pp. 547. Price $3·50.

THE American Association for the Study of Goiter deserves the warmest congratulations of all medical scientists, engaged in the study of the thyroid gland and its disorders, for the initiative it has taken in getting together and publishing in book form the interesting and valuable transactions of the Third International Goiter Conference heid under its auspices last year at Washington, D.C. Though goiter was first clinically recognised more than hundred years ago and considerable amount of knowledge has gathered since then, there are quite a number of questions which remain still unanswered. The International Goiter Conference has not only attempted to review and bring up-to-date the modern status of knowledge about thyroid disorders but, by many original articles and discussions contributed by some of the world-renowned specialists, has tried to indicate newer lines of thought and investigations. There is little doubt that the *Transactions* will be very welcome and largely appreciated by all keen students and teachers of the subject.

Starting off with an ably written *Foreword* and addresses of greetings from the President of the Conference, the Secretary of State for the United States Government and the Chairman of the Reception Committee, the subject-matter is presented in thirteen sections as follows: (1) Etiology—Radioemanation; (2) Prophylaxis; (3) Congenital and Childhood Factors; (4) New Growth and Infection; (5) Special Endocrine Aspects; (6) Surgical Aspects; (7) Medical Aspects, Cardiac and Renal Aspects; (8) Iodine; (9) Vitamins and Thyroid; (10) Research; (11) Metabolism and Basal Metabolic Rate; (12) X-ray; (13) Colloid Goiter. From the titles of the sections, it will be apparent that nearly all aspects of the thyroid problem have been touched and discussed. The arrangement of the various articles has been executed with commendable judgment, enabling readers with different fields of interest such as the clinician, the public health worker, the surgical specialist or the laboratory investigator to concentrate attention on their individual specialities easily. It is difficult to single out from such a formidable array of well-written articles by renowned workers any particular note for special mention, but presumably, writings from authorities such as George Crile, David Marine, H. Eggenberger, Henri Welti, J. B. Collip, F. H. Lahey, I. S. Ravdin and A. C. Wegelin will attract more attenton than others.

In the concluding lines of the *Foreword*, the American Association for the Study of Goiter states, "To the profession we offer this volume in the conscious pride of its potentiality—as a strategic and valuable reference work, to everyone directly or remotely interested in the fields of the study of Goiter". The Association, it must be admitted, has succeeded in its endeavour. The treatise is undoubtedly a valuable collection and presentation of current knowledge about the thyroid gland and its disorders. Superbly bound and richly got-up, with clear illustrations and neat Zinc-cuts, the volume will be a welcome addition to all medical institutions and post-graduate medical libraries.

B. MUKERJI.

The Philosophy of Non-Violence—A Scientific Approach

Mahatma Gandhi—*Essays and Reflections on his life and work—presented to him on his Seventieth Birthday, October 2nd*, 1939. Edited by S. Radhakrishnan. (George Allen & Unwin, Ltd., Museum Street, London), 1939. Pp. 382. Price 7*sh.* 6*d.* net.

BETWEEN scientific pursuits determined strictly under the rigorous conditions of laboratory control with perfected weapons of verification or demonstration, and hero-worship religious and political essentially and basically grounded on emotional admiration which is at the very antipodes of rational reflection and balanced judgment, a wide and practically unbridgeable gulf yawns, and from the scientific standpoint represented by a distinctive periodical like the *Current Science*, unique in the history of Indian technical journalism, it is undoubtedly difficult to review a volume like the present one in which sixty-three persons distinguished in their own way, men and women, Indians and Europeans, have paid eloquent tributes to Mahatma Gandhi on the occasion of his seventieth birthday. The Press in both hemispheres has welcomed the volume as one calculated to alter altogether the face of modern civilization built on force, exploitation and armament on a colossal scale. The volume is edited by Sir S. Radhakrishnan of the Calcutta and the Oxford Universities, now appointed Vice-Chancellor of the Hindu University at Benares. The Editor has contributed an "Introduction" on "Gandhi's Religion and Politics" (Pp. 13–40). The others, sixty-two in number, have not only paid their tribute to Mahatma Gandhi as an apostle of non-violence in thought, word and deed, but also commended non-violence as the only weapon of adjustment of individual, national and international relationship in a distracted modern world, the tributes varying in length from a short paragraph to a number of pages.

The publication of the volume would afford the occasion for discussing the philosophy of non-violence as a weapon of adjustment of secular affairs. In addition to the entire mass of Gandhian literature now available, the volume under notice should be studied against the background supplied by a sensational work like "Gandhi and Anarchy" written by the late lamented Sir C. Sankaran Nair. To-day poor Mr. S. Srinivasa Iyengar seems to be the solitary person who, day in and day out, tirelessly tells audiences steeped to the point of saturation in Gandhi-worship that Religion and politics should be separated from one another. Political memory is so conveniently short. In a way, Nemesis appears to have overtaken Mr. Srinivasa Iyengar. For, it was he who, once upon a time wanted the spiritualization of politics.

Be that as it may, what is the philosophy of Non-Violence? Is it possible to proceed along a strictly scientific approach? There is universal agreement on what constitutes scientific verification. A suggested law or hypothesis should be verified in reference to Positive test-instances as well as Negative test-instances. Then alone the hypothesis would rank as a verified Universal Law. Pure psychological analysis would reveal the existence of *three* types of conflict: (1) Individuals come into conflict with one another in the matter of their rights and privileges. (2) Individuals come into conflict with the State. (3) States and Nations come into conflict with one another. Other types may easily be subsumed under these. Since the dawn of reflection, a life of love based on non-violence has been commended as the ideal by all thinkers and seers. The Vedantic system-builders, Christ, Buddha, and others have all proclimed and praised the gospel of non-violence. Latterly, Tolstoy added emphasis to it. Mahatma Gandhi, thus, by no means is the first to have proclaimed the gospel.

Non-violence in *thought* will never admit of laboratory verification. Thoughts violent and non-violent, being too subjective, will never lend themselves to verification under laboratory control. Non-violence in word and deed being objective or involving consequences and effects in the objective world from which appropriate responses must be elicited, would be capable of verification. Before Non-violence is admitted to be a gospel universally applicable and universally valid, positive and negative test-instances should be furnished. That is to say, Non-violence and the promised millennium or even limited returns in material and spiritual currency should be shown to be casually connected with one another in a number of positive instances. Even so, it shoud be shown that *absence* of non-violence is invariably and unconditionally linked with the *elimination* of the consequences, namely, the millennium or the limited returns. Then, and then alone, would verification be complete. Proceeding along this line of

investigation, it would not be difficult to demonstrate that Non-violence can *never be universalized*. If, to err is human, a certain amount of violence is included in the error. To be violent is human.

If emotionalism, sentimentalism and time-serving loyalty to this or that creed be eliminated, the reason why Non-violence *cannot* be universalized would be immediately apparent. Unless both the parties to the conflict or controversy admit the validity of non-violence, its one-sided exercise would mean victory for one and total extinction or annihilation for the other. I do not know if it is at all true. Mr. George Bernard Shaw is believed to have administered a knock-out blow on the head of the doctrine of non-violence. He seems to have emphatically stated that the non-violence of the Cow would never convert the Tiger into a vegetarian.

The argument that if Belgium had remained *strictly* non-violent in thought, word and deed, if Abyssinia had followed suit, and if to-day the Jews and the Poles had remained non-violent in thought, word and deed, the war-mongers would have been discomfited, can be advanced only by those whose kith and kin, person and property are all protected and guarded by others. Mr. Arthur Moore, Editor of the *Statesman*, Calcutta, an ardent admirer of Gandhi and Radhakrishnan, observes that the Pacifist argument was refuted by Krishna in the *Gita*, and that Gandhi held the argument of the *Gita* did not apply to physical war. Both views are untenable. The Lord Krishna has definitely stated that War is used by Him to rid mother earth of the burden of arrogant mankind. Yet, pacifism is the ideal of all who aim at realization of the Supreme Self Immanent in Reality. Pacifism can never be a political prophylactic or panacea. Nobody could have forgotten Gandhi's great argument that the Behar Earthquake was due to the treatment meted out to untouchables. If war, even as evil, is a permanent factor of the cosmos which God Himself employs to rid mother earth of her burden, and if the pseduo-pacifists advocate the turning of the left cheek in all crises and emergencies, they must be deemed to be working against God. Let there be no illusions, however. I am afraid within the limits of this notice, the philosophical problems cannot be argued out. In God's universe, there is as much place for war as for peace, as much for good as for evil. One thing is certain. Unless politics and religion are kept rigidly separate from one another there would be only pinchbeck politics, simulacrum of spirituality and rope-snake religion.

Amusing errors occur in the volume, citational, interpretational, and typographical. I leave it to the readers to discriminate which is which. (1) On page 32 occurs the citation *Frano Virat*, which a distinguished person in Madras, one very near the Rose if not the Rose itself, read as *Franco Virat* in view of the recent successes of General Franco in Spain! It is a pity the Editor did not give the exact reference. It is from the Whitney's translation of *Atharva Veda*. It should be "*Prano*", and not as actually printed. The text in the said context means something which has absolutely no connection with Satyagraha, Love, etc., in support of which it is cited. (2) A truncated sentence is cited from the *Isavasya* Upanishad on page 19. No reference is given. It is cited to support the dictum "love thy neighbour as thyself", "*atmaiva*". In a book intended to inculcate non-violence as a Universal Gospel, I submit it is a violent outrage to translate or interpret "thyself" into "*atmaiva*". The text sings the glory of the spiritual vision of the blessed "*Adhikari*" who sees God in all, and all in God. (3) A. Berriedale Keith who divides his researches between Panditry in interpreting Indian and other Constitutions and Panditry in Sanskrit Literature, does great violence indeed to a popular Sanskrit stanza which every school-boy is expected to know. The correct quarter is "*Ayam...Nijah...paroveti*" and not as actually printed. (4) But, the funniest error is that Srimati Sophia Wadia is said to be the founder in India and Editor of the Indian P. E. Z.! (P. 295.) It should be P. E. N. (5) Finally, Dr. Muirhead, General Editor of Library of Philosophy series, in which Sir S. Radhakrishnan's volumes on "Indian Philosophy" have appeared, writing on the "Hindu Idea of Truth" again, does great violence to the Vedantic Concept of Truth and Reality. Propositional quibbles and legerdemain like "Truth is God", "God is Truth", will not bear a moment's metaphysical scrutiny. The Vedanta long ago rendered a most satisfactory answer to the problem in question. God was deliberately and definitely defined as the Creator of the World, its protector, destroyer, etc. ("*Janmadyasya Yatah*"). The God of Philosophy thus defined has nothing to do with the Truth that H_2O is water or that Philosophers care as much for their monthly salary as others.

In any scientific study of the philosophy of non-violence, the following facts should be borne in mind: (1) Rama admitted to have been God incarnate had to wage war. (2) Krishna did the same. It is recorded in the epic that even the exhibition of the Lord's cosmic form did not move Duryodhana. Balarama, unable to prevent war, went on a long pilgrimage. Vyasa did not prevent the Mahabharatha War. He was God incarnate. Krishna did not. Indian philosophy may be good, bad, or indifferent. If hopes are entertained in any quarters, and if the claim is seriously advanced that International dispute and dissentions should be settled by reference to any Indian or European Panchayat of Pacifists, those who urge such claims and those who lend their ears to them cannot but be considered to be doped denizens of *limbus fatuorum*. Modern countries which, for whatever reasons of ideology and whatever causes of equipmental incapacity, fail to arm themselves to the teeth as it were, fail to keep the powder dry, of course with plenty of faith in God, and fail to adopt modern methods and weapons of warfare, would be permanently at the mercy of the aggressors. If modern governments have paid police to protect persons and property they should have paid Military Units as well. On the plane of reason, there is no escape from this conclusion.

R. NAGA RAJA SARMA.

Sugar Industry of India, 1937–38*

THE year 1937–38 was an eventful one for the world sugar industry. The International Sugar Conference allocated export quotas among the various sugar-producing countries. No quota was however allotted to India, this country having agreed not to export sugar to any other country except Burma. The world sugar production during this year was 30,991,000 tons, showing an increase of 173,000 tons over the previous year while the sugar consumption during the same period was 29,757,000 tons showing a decline of 792,000 tons.

In India the total area under sugarcane during 1937–38 was 3,815,000 acres showing a decrease of 14% from the last year and similarly, the total cane grown was also less by 17·4%. The season was not quite favourable as the crop suffered from insufficient rain in its initial period. Owing to shorter duration of the season and inadequate supply of cane there was a large decline in the production of white sugar which was 930,700 tons as against 1,111,400 tons of last year. The total number of factories that operated this year was 136. White sugar production by the indigenous process was 125,000 tons as against 100,000 tons of the previous year.

During the year 1937–38 there were no changes in the rates of excise duty on sugar or on the import duty on foreign sugar and molasses. Export of sugar from India by sea was 14,296 tons as against 521 tons of the previous year. Imports of foreign sugar showed a sharp decline to 13,715 tons from 23,100 tons of last year. Only a small portion of the sugar required for consumption in India was thus imported because the production in the country almost balanced consumption.

There was a decline in the 'gur' production from 4,268,000 tons last year to 3,364,000 tons—about 21%. The total production of molasses in the Central Sugar Factories, working directly with cane amounted to 349,600 tons. Though separate figures for export of molasses by sea are not available, the total export of molasses, palmyra and cane jaggery during 1937–38 was 79,167 tons while the figure for the previous year was only 24,195 tons.

The record production of sugar in the year 1936–37 brought with it a phenomenal decline in sugar prices which led to a drastic reduction in the area cultivated for cane and sugar produced in the following year 1937–38. This curtailment, in its turn, resulted in a rise of price in Indian factory sugar till they reached the parity level with imported sugars, which is acting again as an incentive to the growers for planting more cane. With the continuation of these conditions, there is always the danger of overproduction with its attendant difficulties following a period of prosperity. It is desirable, therefore, in the interest of the stability of the Indian Sugar Industry, that any future programme of cane cultivation and sugar production must be so planned as to assure both the grower and the manufacturer a fair margin of profit over a number of years while the consumer also pays no more than a reasonable price for sugar.

G. GUNDU RAO.

* Review by R. C. Srivastava, Supplement to the *Indian Trade Journal*, November 2, 1939.

Recent Advances in Applied Mechanics

Proceedings of the Fifth International Congress for Applied Mechanics. (Published by John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., London), 1939. Pp. xxi + 748. Price 30*sh*.

THIS publication is a unique collection of more than one hundred papers dealing with the subject of Applied Mechanics. They represent the work of many eminent research workers gathered together for the Fifth International Congress of Applied Mechanics held at Cambridge (Massachusetts U.S.A.), during September 12–16, 1938. The papers are classified under the heads:—

(1) Elasticity and properties of Materials: There are 47 of these preceded by three general papers. (2) Mechanics of fluids: These are 66 in number, of which three are of a general character. And (3) Dynamics. There are 17 papers in this Section. Although some of the papers are purely theoretical and mathematical in character, the bulk deal with the application of theory to problems of great practical importance to the engineer. Experimental methods for testing the truth of the theory are described in a number of them and conclusions drawn to serve as a guide for the future progress in design. It would probably be invidious to select from among the papers, but the following references are merely given as samples.

Dr. D. M. Smith of the *Metropolitan Vickers* has contributed a paper in which an attempt is made to estimate the stress and deflection in a built-up half diaphragm as commonly used in Impulse Steam Turbines. The deflection is obtained by calculating separately the deflections of the centre and of the blading assuming a certain distribution for the supporting reactions round the periphery. Curves are given for enabling ready calculation. The values as deduced by this theory were tested experimentally by loading of a large number of diaphragms by means of hydraulic rams. The agreement was very satisfactory, especially in the case of diaphragms with relatively thin centres.

A study of the stresses and displacements in two-hinged Vierendeel Truss arches is made by Professor Maugh of the *Michegan University* with the aid of brass and celluloid models. Some of the conclusions drawn are of general interest in the design of continuous frame structures, notably the one about the stiffness being dependent on the physical characteristics of the joints, and the possibility of the joint-action being expressed in suitable slope-deflection coefficients.

A method of measuring "integrated roughness" of surfaces machined or hand finished is described by Pierre Nicolaw making use of an apparatus which is called "Micrometre Pneumatique Solex". Air is allowed to escape through a specially constructed orifice placed over the surface whose roughness is to be measured. A scale of roughness could be constructed from the quantity escaping which is observed by a manometer measuring the air pressure.

Professor H. F. Moore of Illinois and R. L. Jordan contribute a paper on stress concentration in steel shafts with semicircular notches based on an experimental study. Fatigue tests were made with the Standard Woehler Type of machine.

The problem of failure of materials under combined stresses forms the subject of an experimental investigation by Prof. Lessels and Mac Gregor of the Massachusetts Institute of Technology. The hollow test bars were subject to internal pressure and at the same time, axial tension. The lateral strains were noted with a newly developed hydraulic lateral extensometer which gave the average strain over a considerable gauge length from the displacement of a quantity of water placed in a metal jacket surrounding the test piece. It is stated that the constant energy of distortion theory was well supported by the test results.

The application of Photo-elastic methods of studying stress problems is described in three papers. The beautiful photographs illustrating the "Frozen Fringe Patterns" obtained with a transparent bakelite test piece by M. Hetenji, as well as other investigators described in these papers indicate that in this method the research worker has in his hands a valuable tool giving

a visual picture of the state of stress in a body.

An automatic relaxation machine to measure the creep properties of a metal stressed under high temperatures was used by Dr. A. Nadai and J. Boyd of the *Westinghouse Research Laboratories*. The work was undertaken with special reference to bolted flanges where the total deformation (elastic + plastic) remains constant and creep takes place under decreasing stress. The work is stated to be still in progress with a view to present a comparison of the test results obtained with creep data already available under a condition of constant loading.

In the section of Mechanics of Fluids, Mr. C. H. Chatfield of the *United Air-Craft Corporation*, U.S.A., surveys in a paper the entire field of development of the air plane structure along with the engine. No part of the aeroplane has been left untouched in this connection. The problems that have confronted Aeronautical Engineers in the past have been carefully analysed and the ways by which successful solutions were obtained are described in a clear and concise manner. Trends in future design both as regards new material and its application are predicted and the conclusion is drawn that research in applied mechanics would be of great help as in the past to the aeronautical engineer in overcoming his special difficulties leading to steady progress.

The phenomenon of turbulence in fluid motion is the subject of a number of papers. The statistical theory is discussed in several papers by Professor Th. Von Karman, Professor Norbert Wicner and others. Professor Kampe de Feriet of the *University of Lille*, France, describes some researches in this connection made to measure the diffusion of very small soap bubbles (3 to 4 m.m. in size) in vertical and horizontal wind tunnels.

The reduction of drag in air-craft is of paramount interest and there are a number of papers dealing with this subject. The effect of surface roughness is the subject of an experimental study by E. F. Relf of the *National Physical Laboratory*. A model of the R. 101 air-ship envelope about 4 feet long was tested. The effect of rivet heads, lapped plates on aerofoils was also studied. Full-scale tests generally confirmed the deductions from model work. Dr. William Bollay of the *Harward University* develops a theory applicable to planing surfaces like sea-plane floats, explaining the differences observed by experimenters between the behaviour of air-foil and gliding surfaces.

The lines of flow in an aerodynamic field are studied by Professor J. Valensi (Marseilles), with the aid of smoke consisting of air charged with ammonium hydrochloride. The injection of the smoke is either continuous or in puffs whose frequency may be regulated. The flow lines are observed by illumination from a source of light which may vary to give a stroboscopic effect or may be continuous. Motion round propeller blades, and different wing profiles have been studied.

Professor Knapp and Dr. Ippen contribute a paper on the characteristics of "shooting flow" in open channels round curves. In a long curve a series of rises and falls in level occur both along the outer and the inner walls of the channel and this pattern persists to a considerable distance downstream. A tilting platform 100 feet by 10 feet was used to vary the slope in the experimental channels. These experiments were necessitated by the concern felt by the engineers over the design of curves for the storm water channels of the Los Angeles County Flood Control. It is stated that sills and transition curves suitably placed damp out the disturbance pattern appreciably in the case of rectangular channels.

The mechanics of sediment suspension is a subject of topical interest to hydraulic engineers the world over with reference to irrigation, river-regulation, &c. Some experiments to elucidate this matter conducted by Professor Rouse of Pasadena are described in a paper. A theory is developed for the distribution of sediment under equilibrium conditions based on the analogy of an expression which has been used for the transport of momentum per unit fluid volume in a liquid in which fully developed turbulence exists.

The question of transfer of heat across metal partitions under conditions leading to evaporation of liquids at a high or low pressure is the subject-matter of a paper by Professor Max. Jakob of Chicago. The coefficient of heat transfer in tubes (such as are used in boilers) under such circumstances is higher than in wide vessels. A formula is developed based on various assumptions to apply to the case of horizontal or vertical walls, and fairly good agreement has been

found experimentally but it is admitted further work is necessary. The effect of vibration on heat transfer from a horizontal cylinder is studied by Professor Boelter and Martinelli with the aid of a special apparatus devised by them.

The phenomenon of cavitation is studied by Professors H. Peters and B. G. Rightmire by the vibratory method using a brass test specimen screwed into a nickel tube and vibrating in fresh water, the vibrations being produced electrically. The test results lend support to the hypothesis that the damage suffered under these circumstances is due to a series of impacts produced on the specimen by the periodic collapse of vapour at the vibrating surface.

Four papers on the mechanism of fluid film lubrication in journal bearings are included. There has been a vast amount of work in this field and both research and theory have enabled one to form a fairly correct picture of what is happening. Recently the effect of pressure in increasing the viscosity has been studied. This is of importance in heavily loaded bearings like those of roll necks of rolling mills. There is then the phenomenon of oil film whirl or instability in the position of journal producing objectionable vibrations. The application of the results of research to the field of practical bearing design is still not so well established as one would desire. The work done in the United States regarding these problems is presented in the form of a summary by Professor Karelitz, De Newkirk and Needs, members of the special research committee on lubrication appointed by the *American Institution of Mechanical Engineers.*

In the Dynamics section, Dean A. R. El. Sawy of the *Egyptian University* contributes a paper on a method of computing the I.M.E.P. of an internal combustion engine working on the 4-stroke cycle. It is stated that the point in the stroke where the pressure is equal to the mean effective pressure is the same for all the cards taken from an engine in normal operation at different loads and speeds. Theoretical and experimental work in support of this contention is offered.

The measurement of transient impact strains by the change in electrical resistance undergone in a thin strip of elastic material cemented to the strained surface is described in a paper by Professor De Forest, of the *Massachusetts Institute of Technology.* The changes in strain could be recorded photographically by means of the Cathode-ray Oscillograph. A check calibration was carried out using a U-shaped metal bar and allowing it to vibrate as a tuning fork. The recorded strain was compared with that obtained by calculation from the St. Venant Formula. The difference was only ½ per cent. It is stated that this method enables one to measure stresses propagated at the speed of sound and "impact strains need no longer remain in the realm of conjecture".

The subject of vibrations and their cure from the topic of a number of papers among which may be mentioned the following: "Vibration Isolation of Air-craft power plants", by E. S. Taylor and K. A. Browne. "Sur La Suppression Des Vibrations a Bord des Grands Paquebots", by Henry Beghin. The latter has reference to the disturbing vibrations experienced in the ship "*Normandie*" when she first put out to sea. The paper on "Spiral" vibration of rotating machinery by R. P. Kroon and W. A. Williams contains a theory based on the hypothesis that temperature distortion of the roter is responsible for the continuous change in unbalance observed under these circumstances. A simple test set-up was used to check up the theory. Further work is considered desirable, to reduce the number of assumptions that are made in what is stated to be a preliminary investigation.

The Cathode-ray Oscillograph is employed by Professor Draper and Philip M. Morse for finding the size and location of the region of detonation in an Internal Combustion Engine. The application of acoustic theory of standing waves is made in this connection. Use was made of the properties of these waves as predicted by the theory and instantaneous pressure Oscillations were simultaneously observed at two different points within the engine cylinder. An interesting conclusion made by the authors is that the detonating region is next to the cylinder wall and often has a greater spread along the wall than away from the wall.

This collection of papers is thus of very great interest and importance to workers even in kindred subjects and the new methods of attack described offer great scope for further research. The typography and get-up leave nothing to be desired and the illustrations and graphs form additional attractive features.

E. K. RAMASWAMI.

CENTENARIES

Cockburn, William (1669–1739)

WILLIAM COCKBURN, a British physician, was born in 1669. After taking his M.A. at Edinburgh, he proceeded to the University of Leyden of which he became an M.D. In 1694 he was appointed naval physician and he seems to have retained this position till 1731, when he joined the staff of the Greenwich Hospital. Cockburn was physician to Jonathan Swift.

Remedy for Dysentery

Cockburn had a secret remedy for dysentery. In July 1696, when he was dining on board one of the ships, Lord Berkeley remarked that 'there was nothing farther wanting but a better method of curing fluxes'. Cockburn announced his secret remedy which when tried next day upon seventy sailors proved a brilliant success. The result was reported to the Admiralty Board and the remedy immediately came into official use and remained so for forty years, not only in the navy, but also in the army. This was looked upon as a benefit of national importance and William III personally conveyed the nation's thanks to him, although he was bitterly opposed as a quack by academical physicians. Nothing is now known of that wonderful remedy.

His Writings

Cockburn was a writer of some importance. His only contribution to the *Philosophical transactions* of the Royal Society was on "The operation of a blister". Its object was "To give a reasonable conjecture how a blistering plaister, the chief ingredient of which is cantherides, may cure a fever, and its most terrible symptom, a delirium, and that in a few hours".

His Writings

His first book was on the *Nature and cure of distempers of seafaring people with observations on the diet of seamen's in H.M.'s navy* (1696). In those days there was no notion of the importance of succulent vegetables in this matter; hence Cockburn's sarcastic remark that people "at the name of scurvy, fly to scurvy-grass, water-cresses and horse-radishes". His other books were on the *Lues venerea* and on the *Symptoms, nature and cure of gonorrhœa*. The latter went through four editions and was translated into other languages.

Cockburn died at London November 1739.

Hewson, William (1739–1774)

WILLIAM HEWSON, a British anatomist, was born at Hexham, Northumberland, November 14, 1739. Having been apprenticed to his father who was a surgeon, he studied at St. Thomas's and Guy's hospitals and attended the anatomical lectures of William Hunter. Later he became a partner of Hunter in his anatomical school. But the partnership broke and in September 1772 Hewson began to lecture independently at a theatre which he built near his house. His reputation was so high that he had no difficulty in attracting a large class.

His Researches

Hewson's researches on the blood were of great importance as establishing the essential character of the process of coagulation and the forms of red corpuscles in different animals. He also made valuable contributions to the study of the lymphatic system in fishes.

His Publications

Hewson's first book came out in 1771 under the title *An experimental enquiry into the properties of the blood*. He wrote two more books, one on the lymphatic system and the other on the red corpuscles. Besides these he wrote about ten papers, most of which were published in the *Philosophical transactions* of the Royal Society. His *Opera omnia* was published in Leyden in 1795, while an English edition of his *Collected works* was brought out by the Sydenham Society in 1846.

His End

Hewson wounded himself while making a dissection and serious symptoms followed. He died after a few days' illness May 1, 1774.

Murdock, William (1754–1839)

WILLIAM MURDOCK, a British engineer, was born at Bellow Mill, Ayrshire, August 21, 1754. Brought up as a gunner—his father and grandfather were so—he entered the service of Boulton and Watt at Soho in 1777. Murdock's unambitious career was entirely devoted to the interests of his employers. He had no leisure to devote to any sort of recreation. The rising sun often found him after a night passed in incessant labour still at the anvil or turning lathe, for with his own hands he would make those articles he would not trust to unskilful ones.

The First Locomotive

His fame had been somewhat overshadowed by the great name of Watt. But the first locomotive was made by Murdock. It was constructed entirely by his own hands. One night, after returning from his duties, he wished to put to the test the power of his engine, and as rail roads were then unknown, he started the locomotive in a dark night on a narrow path in the church compound, himself in full chase after it. Shortly after, he heard a distant despair-like shouting; he soon found that the cries for assistance proceeded from the pastor of the church who, going into the town on business, was met in this lonely road by the fiery monster, whom he subsequently declared he took to be the Evil one in *propria persona*.

The First Coal Gas Light

Murdock is still better known to the public and most deservedly so, by his invention of

applying the gas from coal to economic purposes. Although the gas had been discovered and obtained both naturally and artificially more than half century before, nobody had thought of this application. He perfected the mechanism for such a gas light and described it in the *Philosophical transactions* of the Royal Society in 1808. This earned him the Rumford gold medal of the Society.

PNEUMATIC INVENTIONS

Murdock had made many mechanical improvements in the equipment of the Soho Foundry. Prominent among them is the construction of the first pneumatic lift for the purpose of raising and lowering the castings from the boring mill to the level of the foundry. He was also the first to make use of compressed air to ring the bell in his house and in the office. He was the inventor of Cast-Iron Cement which is now so much used in the construction of engines and machinery. He invented a crown-screw by which marble and stone could be bored for use as water pipes.

HIS END

Murdock was also the first to invent central heating. While engaged on the erection of this apparatus at Leamington, he met with a severe accident by the fall of a ponderous cast-iron plate upon his leg above his ankle. He never recovered completely from the effects of this injury.

Murdock died November 15, 1839.

ASTRONOMICAL NOTES

Planets during December 1939.—Venus continues to be an evening star and will be visible low down in the western sky for about an hour and a half after sunset; Mercury will be at its greatest elongation from the Sun (21° 25'W.) on December 17 and can be seen for a short while before sunrise. Mars is rapidly moving eastwards in the constellation Aquarius and although decreasing in brightness, will still be a conspicuous object in the western sky in the early part of the night.

Jupiter will be on the meridian at about sunset and continues to be well placed for observation. Saturn moves slowly in a retrograde direction near the western border of Aries and becomes stationary on December 29. The rings can be seen fairly widened, the angular dimensions of the major and minor axes being 43" and 10" respectively about the middle of the month. Not far eastwards of this interesting planet, will be Uranus which can be easily located about 2° south of the star δ Arietis (magnitude 4·5). Neptune is in quadrature with the Sun on December 18, and is stationary on December 29. It is situated about a degree to the north of β Virginis and can be observed with some optical aid. A lunar occultation of some interest that will be visible in India is that of β Capricorni (magnitude 3·2)) on the evening of December 14.

Jupiter X.—Two extremely faint satellites (X and XI) of Jupiter were discovered last year by Dr. Nicholson at the Mt. Wilson Observatory. From the revised orbit of J. X published by R. H. Wilson (*P.A.S.P.*, August 1939), it is found that the mean distance is ·077 astronomical units and the period 252·8 days. The orbit of this satellite appears to be very close to those of J. VI and J. VII. T. P. B.

MAGNETIC NOTES FOR OCTOBER 1939

MAGNETIC ACTIVITY.—The terrestrial magnetic activity during October 1939 was larger than that in the previous month. There were 6 days of *moderate* disturbance, and 16 of *slight* disturbance. The number of days of *great* disturbance was only one while 8 *quiet* days occurred during the month.

It is interesting to note that the most disturbed day in the month that of 13th October occurred immediately after the 12th October which is the quietest day during the month. The distribution of the magnetic characters* of individual days is shown in the table below.

Dates of the month	Quiet days	Disturbed days		
		Slight	Moderate	Great
1939 Oct.	8, 12, 20, 24, 25, 27, 29 and 31	1, 2, 5 to 7, 10, 11, 16 to 19 21, 22, 26, 28 and 30	3 4, 9, 14 15 and 23	13

Magnetic Storms.—A storm of great intensity with "sudden commencements" in H, D and Z, was recorded on the 13th and 3 moderate storms each with a gradual beginning occurred on 2nd, 9th and 14th respectively. The number of disturbances during October 1938 were three (one great on 7th, and 2 moderate on 23rd and 25th).

Monthly Characters.—The mean character figure for October 1939 is 0·97 as against 0·94 for the corresponding month of 1938.

M. R. RANGASWAMI.

Tambyacha Bungla,
Colaba, Bombay 5.

* For method of characterisation please see "Magnetic Notes for July, 1939," in *Curr. Sci.*, 1939, **8**, No. 9, 434.

Perspectives in Evolution*

A CORRECT understanding of the implications of the rapid discoveries being made in Zoology since the beginning of this century can only be had by an examination of these discoveries with reference to the long range view of the existence of life on this earth and this is the thesis examined by Prof. Ritchie in his address to the Zoology Section. The first of these long range views concerns the origin and nature of life. The author examines the mechanistic and vitalistic conceptions of life, the vortex theory, the equilibrium theory and also the bearing of enzyme actions on the understanding of life's processes but concludes that none of these ever offers a complete understanding of its mystery and secret. The characteristics of life are very different from the characteristics of lifeless things and in fact the processes governing the actions of the two are different and are probably completely opposite. The power exhibited by living organisms to abstract from the atmosphere, their medium and generally from their environment, materials that are found in very small quantities, is one which has no parallel in nonliving things, for physical laws tend towards a maximum dispersal of their particles instead of their segregation. But yet the actual mode of the origin of life on earth eludes us. It may be said that life originated as a result of a concourse of atoms but this is more a possibility than a probability. It is impossible too, to say what the first living thing looked like, whether it was a virus, a bacillus or just an undifferentiated mass of protoplasm capable of reacting to its environment. It therefore becomes necessary to take the origin of life as an axiom and once this is done, all the different biological phenomena become explicable.

There is still another concept of life which is as breath-taking as it is baffling. It is now estimated that life has existed on the earth for perhaps 1,200 million years and that the earth itself is about 2,000 million years old. Against this stupendous background of time has Evolution been progressing, slowly and with limitless patience. Against this background man appears but an insignificant thing, his part in evolution a microscopic one, his activities but a tenuous struggle. He appeared on the earth from 25,000 to 40,000 years ago but only very little of this period—in fact only the last 300 years—has witnessed any of his great transformations. As Prof. Ritchie picturesquely puts it, man's achievements have been crowded into less than one-tenths of a second of a twelve-hour past life of the earth.

There is yet a final question which Prof. Ritchie asks,—what of the future of Man? If we assume that life will continue on earth for as long as it has existed already, it must be admitted that evolution will continue. What will the human being at the end of earth's life look like? Nobody can tell. Science is unable to forecast the long future of evolution. It has often been said that man is the culmination of evolution and the future of evolution must only consist in a development of individuality of mental and intellectual ability and in the perfection of a great social order. But when the huge past of over a 1,000 million years has produced such a wealth of evolution, is the huge future of about the same period likely to produce nothing more or better than just a better man? It is on the other hand more probable that man is but a stage in life's progress, just as the dinosaurs were in the Triassic period. And what the future lines of this progress are, nobody can foretell, nor even imagine.

* Summary of the Presidential Address by Prof. J. Ritchie, Zoology Section—Brish Association for the Advancement of Science, Dundee, 1939.

The Assessment of Physical Fitness*

EVERY one talks glibly of Physical Fitness. Many are unaware of its implications. Diverse definitions are given and though we are generally aware of the many qualities that a fit person should possess, we are unable to test those qualities in the light of what is expected of them. Is it a good configuration of the body, is it physiological efficiency or is it the possession of a superior mental equipment that is the criterion of physical fitness? This question is examined by Prof. David Burns in his address to the Physiology Section. It must be admitted that data regarding the form and stature of the body are valueless in testing physical fitness and an undue emphasis on somatometric assessment alone is liable to mislead us. It is true certain initial advantages or disadvantages are conferred on subjects who are endowed with positive or negative qualities regarding form and stature of body but only when they are associated with other functional qualities are they of any value in assessing physical fitness. Physical fitness is primarily physiological. Of the different kinds of measures of physiological fitness indicated, the most important are the efficiency of the functioning of the cardio-respiratory mechanism, the rate of heat loss under different conditions and the value of muscle tone. On the other hand, the quality and state of mind are also of great importance in assessing physical fitness and there is really a close correlation between the state of one's mind and the amount as well as quality of functional activity one is able to put in. It may be true that man was asked to earn his bread by the sweat of his brow, but there was really no intention of precluding him from taking a joy in his work. In fact, in this the secret of efficiency lies. "Our natural strength lies in our men and women and not in the machines that they tend or the battleships that they man. To be really great a State must have citizens fit in body as well as in mind."

* Summary of the Presidential Address by Prof. David Burns, Physiology Section—British Association for the Advancement of Science, Dundee, 1939.

Measuring the Mental*

R. J. BARTLETT in his Presidential Address has attempted a fairly exhaustive survey of the field of Experimental Psychology with special reference to practical achievement in terms of "Measurement" of the phenomena studied and investigated by Psychology. Reference is made at the outset to the existence of divergent views on the matter and manner of measurement in psychology. Prof. Spearman asked if the data of psychology would admit of what is properly called measurement. Dr. William Brown interested in medical psychology would appear to deny the possibility of measurement of mental phenomena. Malebranche, Leibniz, Kant, and some physicists have ruled all measurement out of order in psychology. Notwithstanding all this, the term "measurement" has come to stay in the literature of psychology. Experimental Psychology is a little over fifty years old. The Presidential Address reviews Experimental Psychology bringing out the senses in which the term "measurement" is being used by psychologists.

Metre scales and foot-rules, balances and weights, chronoscopes and stop-watches, resistance boxes, galvanometers, photometers, *et hoc* are used by Experimental Psychology. Results of bodily activity carried out under controlled conditions were measured. The Gaussian continuous function would as well represent the law of distribution of the results of the bodily expression of mental intention. After referring to the reaction-time-experiment and measuring of the scatter value, R. J. Bartlett discusses at considerable length the Weber-Fechner Laws, and indicates the conclusion that "experiments have measured not the sensitivity of sensory discrimination but rather, the 'constant error' due to the regression of the memory image of the first stimulus towards the values of the central zone of adaptation". The Address then deals with the physiological concomitants of emotional experience, and the so-called Intelligence Tests. Of course, in any discussion of the Intelligence Tests, Prof. Spearman's G (general ability) and S (special aptitude) must appear.

When physical measurement is impossible, R. J. Bartlett proceeds to observe, rankings will have to be secured. Colours, pictures, persons, poems, holiday resorts,—I may add favourite film stars—can be arranged in order of preference. The Technique of ranking and grading of attitudes and preferences is explained in detail. Reference is made to Thurstone and Chave's *Attitude to the Church Scale*. R. J. Bartlett concludes his fine presidential pronouncement with a modest claim that all he has been able to do is just to have sampled the methods and results of Experimental Psychology trusting the sample is a fair one.

Two important and significant conclusions emerge from the Presidential Address just summarised. (1) In the first place, the demand made in certain quarters that unless the data of psychology lend themselves readily to quantitative measurement of the type familiar in physics and chemistry one should not accord any recognition to psychology as a science or a systematic science at all has to be judged to be an illegitimate demand as the data from their very nature and constitution do not admit of such exact measurement as noticeable in the case of dead, inert subject-matter. (2) In the second place, measurement of *some distinct sort* is possible in psychology if one should agree to regard, "ranking, grading, and rating..." as processes of measurement.

These two conclusions valuable as they are do not suggest or claim the existence and operation of any fool-proof methods, and instruments of measurement. Serious difficulties are inherent in the very constitution of mental phenomena as distinct and contradistinguished from the physical which under certain well-known circumstances absolutely defy quantitative determination and precise measurement. The well-known classic instance of one smiling and smiling and yet being a damned villain is by no means confined or restricted to the geographical or territorial limits of Denmark. Violent emotions that are furiously agitating the minds of many can successfully be controlled by an adroit effort at dissimulation, the external bodily expressions being reduced to the barest negligible minimum. If conclusions and generalisations in psychology are to be based on such external expressions of emotions which alone admit of quantitative determination or measurement by instruments like the psychogalvanometer, they are bound to be misleading to a degree at which all systematic science and scientification must be bidden good-bye. I would rather suggest that the science of psychology should endeavour to vindicate its status notwithstanding the utter unsuitability of the methods of measurement adopted in the physical disciplines, to characteristically psychological data. R. J. Bartlett's Address is an able survey of the entire field of Experimental Psychology, and after all attempts at escaping from one's shadow, trite as it may seem, must be vain. Psychologists need not and should not be apologetic in emphasizing that certain mental phenomena cannot be measured. They should exhibit as they have hitherto done readiness to measure where measurement is possible and practicable.

R. NAGA RAJA SARMA.

* Summary of the Presidential Address by Prof. R. J. Bartlett. Psychology Section—British Association for the Advancement of Science, Dundee, 1939.

Rates and Taxes*

IN his Presidential Address to the British Association for the Advancement of Science, Mr. H. O. Meredith severely criticised our system of rates and taxes and called for a drastic revision of its technique. He began by saying that the most striking feature of our social and economic evolution has been the alarming increase in our public expenditure, as a result of which greater resort would have to be had to private contributions, which though voluntary in the initial stages, will have to be made compulsory if any large-scale all-round development is sought.

Prior to such an increase in public expenditure a thorough investigation into the incidence of taxation is necessary. The end in view should be the avoidance of all random taxation and the minimising of inequality of incomes. All taxation is distasteful and there seems to be an apathy to the study of the burden of taxation. There is an air of glum frivolity about budget discussions. This is attributable to the feeling that State demands are predatory and that regression is the key-note of taxes on low incomes, of local taxes, and of compulsory health and unemployment insurance contributions. Secondly, there is not that clear relationship between the tax-payer and the government which is so very essential. Lastly, public expenditure being costly, the Gladstonian ideal of allowing money "to fructify in the pockets of the people" is upheld. Victorian finance followed the free and easy dictates of *laissez faire* and had the virtue of logical sequence. Presuming that government is necessary for the restraint of evil, internally and externally, it argued that State interference was unnecessary if men behaved rationally and that the real task of statesmanship was the inculcation of right ideas of citizenship into the body politic.

Modern finance differs from Victorian finance in that it is planless, lacking initiative and not spontaneous; our help is more "like a sop to Cerberus than an orderly rationing of food". This planlessness is nowhere more obvious than in the income-tax allowance in respect of children and the system of de-rating. Formerly the relief in respect of a child was 7*s.* 6*d.* per annum—the cost of a dog licence! To-day it is better and the relief is to the value of £16–10–0. Even now, in its actual working there are certain anomalies, in that for the vast majority of small families the relief is disproportionately large while for the really large ones it is surprisingly inadequate; moreover, the relief accorded to the first child was once less than that for succeeding ones and the rate of relief is still not in harmony with the scales of incomes. Turning to de-rating, a similar vagueness is observable. The central problem of local finance should be the choice of purely local sources of revenue; but here the practical difficulty is to differentiate between local and non-local sources and so long as the scheme aims at excluding non-local sources, the Central Government grants could justifiably be increased in accordance with the ever-increasing integration in local and national life. Mr. Meredith criticises the exemption of any part of concrete capital and land, as de-rating then encourages tranfer of investment from those that are rated and that such properties should pay a consolidated rate into a national pool.

Taking the financial system as a whole, he feels that the income, direct and sur-taxes, and death duties are the best. Income surely is the best index of capacity to pay and an inheritance tax has the virtue of reducing inequality. Applying the same tests to local and indirect taxes he concludes that they are highly regressive, have no relation to windfall incomes and tend to aggrevate inequality. Equally true is this of commodity taxes. Mr. Meredith says "as a method of limiting undesirable consumption, taxation is a 'wash-out'. Its effect is to penalise, not to restrain" and refers to the tobacco and liquor taxes as examples. The main force behind such taxation, he adds, is to be found in the desire of the will-to-do to de-tax wealth and to minimise taxation. Mr. Meredith feels that even income-tax needs tightening up since a number of incomes escape taxation. Local taxes have the pernicious effect of not falling on land-values but on retail goods and house-rentals. In fine, he views with scorn all indirect taxes and asserts that all taxes to be paid must be felt, else it would amount to the State picking the pockets of the people. Finally, he does not favour any system wherein a subsistence minimum is exempted. A sufficiently heavy contribution to be felt should be called for from the very bottom of the scale and in this connection the German example is noteworthy. It is a fallacy to base human association upon equity. All such attempts are doomed to failure. Honour, Mr. Meredith emphasises, must compel every citizen to contribute to the upkeep of the State and aptly concludes, "I am convinced that it is psychologically essential, if we desire to build up a democracy, to enshrine this principle in our financial institutions".

B. V. N.

* Summary of the Presidential Address by Prof. H. O. Meredith, Economics Section—British Association for the Advancement of Science, Dundee, 1939.

SCIENCE NOTES AND NEWS

Nobel Prizes, 1939.—The following awards have been announced: *Physics*: Prof. Ernest Orland Lawrence (California University) for his discovery of cyclotrone. *Chemistry*: Prof. Butenandt (University of Berlin), Prof. Ruzicka (University of Zurich) and Prof. Kuhn (Heidelberg University).

* * *

The Thickness of the Liquid-Vapour Interface of Pure Water.—McBain, Bacon and Bruce (*J. Chem. Phys.*, 1939, 7, 818) have described an apparatus for measuring the surface film thickness of less than a monomolecular order of magnitude. The method is based on the optical theory of Drude. The retardation in phase sustained by plane polarised light at a transparent reflecting surface is compensated and measured by tension on a thin microscope glass cover slip. Experiments with pure water give the lower limit of 2–3 Å for the thickness of the interfacial layer at the liquid-vapour interface of pure water. K. S. G. D.

* * *

Upper Air Study in Madras.—An account of average conditions of temperature, pressure and humidity prevailing in the upper atmosphere over Madras, as obtained from measurements extending over a period of four years, is now published (*Memoirs of the Indian Meteorological Dept.*, 1939, 27, Part 2). Being a coastal station, Madras is suited for this kind of work only in the season in which balloons let off from there will be carried westwards by the winds, *viz.*, the months June to November. The study of the upper air climatology of the same latitude in other months is possible only by having an auxiliary inland station, for which Bangalore has been selected and has been functioning, with the co-operation of the Government of Mysore, from last year. The results of Bangalore can be studied with advantage only a few years hence.

Some of the most interesting results obtained from the Madras data are that between the heights of one and ten miles in the upper atmosphere above the earth, the mean temperature over Madras shows every little change from month to month in the period June to November. In October mean temperatures between one and eight miles are practically the same throughout the north-south extent of India, at least along the central strip. In November, from two to eight miles, Poona is warmer than either Agra or Madras.

* * *

Adulteration of Drugs in India.—Tests conducted recently by the *Biochemical Standardisation Laboratory*, Calcutta, on samples of various medicinal preparations of quinine including mixtures, powders, tablets, etc., have shown that nearly *seventy-five* per cent. of the quinine preparations in the Indian market are adulterated. Many of them contain percentages of quinine far below those required to produce any therapeutic effect while some do not contain quinine at all. A number of cases of malaria which have been found to be "quinine resistant" have been reported. While it is certain that there are types of malaria which are resistant to quinine, it is very probable, in view of the findings of the *Biochemical Standardisation Laboratory*, that in many of these cases, the preparations used for treatment contained little or no quinine. Some time back, the *Biochemical Standardisation Laboratory* carried out similar tests on samples of digitalis preparations and found that most of them were far below the strength prescribed by the pharmacopœia. It can be safely asserted that the position is equally bad with regard to other drugs also. The incalculable harm done to the public by adulteration of foods and drugs has been pointed out again and again and the Government of India has been repeatedly urged to introduce effective legislation to prevent adulteration—but so far with very little effect. No Government which has the good of its people at heart can afford to let the present state of things to go on. The work on quinine preparations done by the *Biochemical Standardisation Laboratory* is only one more proof (if any proof were needed) of the urgent necessity for taking immediate measures to prevent adulteration of foods and drugs in India.

* * *

Mineral Production in India.—The total value of ores, minerals and metals produced in India during 1938 is estimated by the Geological Survey of India at about Rs. 34,13,95,000 or £25,477,000 as against Rs. 30,49,43,000 or £22,928,000 in 1937. This represents an increase of nearly 12 per cent. and is largely due to the record production of coal—28,343,000 tons valued at Rs. 10,64,24,000 or £7,942,000 which exceeds the production of the previous year by over 35 per cent.

Of the other minerals, ores and metals, the production of steel has gone up slightly; pig iron production is also better, but with the fall in price there has been a decline in the production of manganese. Gold output is steady, petroleum has improved and so have building materials and salt, but mica has fallen appreciably and so has copper. Ferro-manganese has more than doubled in value, while in ilmenite, with increasing production, India is leading. Chromite has fallen in value, but monazite, gypsum and steatite have improved. Diamonds, graphite and felspar have improved as against barytes, bauxite, asbestos and tungsten-ore which have declined in value. In bauxite the fall in value is entirely due to the fall in price and not to any fall in quantity. The total values of apatite, beryl, garnet and sapphire production have all fallen greatly.

Occurrence is reported of antimony-ore (zinckenite) in Chitral; explorations are being continued for the discovery of tungsten-ore.

* * *

Eradication of Kans.—The Imperial Council of Agricultural Research have sanctioned a two-year scheme of research for studying *Kans*, a noxious weed ruining thousands of acres of cultivated land in Central India, Bundelkhand and Central Provinces.

Once the weed gets established, especially in black cotton soils, there is no end to the damage. The cultivator is unable to plough it out with the ordinary plough. The weed spreads with ferocious rapidity.

The Bhopal Government purchased two of the heaviest agricultural tractors available in India at a cost of about Rs. 50,000 and spent an additional sum of Rs. 75,000 in ploughing *Kans* infested land to a depth of 10–12 inches. This method brought many a field under cultivation but it could not be regarded as a permanent solution of the problem.

At present scientific information on the life-cycle and root-system of the weed does not exist. Methods adopted in Central Provinces and Indore were found by the Bhopal Director of Agriculture to be helpful to a limited extent in bringing the weed under control but not in eradicating it. He also found that Mr. (now Sir) A. Howard and the late Mrs. Howard's method was too expensive for the cultivator.

In the working of the scheme, the Advisory Board has suggested that a study should be made of the work done on the subject in Central Provinces, Bombay and Indore.

* * *

Recent Work at Rice Research Stations.—On account of the amazing diversity of soil and climate in India, the number of varieties of rice is immense, and the methods of cultivation vary considerably. At one end of the scale, there is deep water paddy such as grows in parts of Assam where the rice stem elongates as the flood water rises and may attain a length of eight feet. At the other, we have in Baroda and parts of Gujerat, rice grown purely as a rain-fed crop without any flooding and sometimes along with and in the same field as cotton. Obviously no single central station can tackle all the problems connected with rice.

The problem of producing suitable rices for export has been investigated at some places. In Bengal several crosses have been made to evolve high-yielding strains of rice conforming to the requirements of the export trade for Britain. A hybrid strain has been evolved which is close to the *American Blue Rose* in size and texture. An improved strain *Gosaba* 23 is distributed in the regions where the quality of *Patnai* rice, a favourite export strain, is found deteriorating.

In addition to the obtaining of varieties with higher yields, plant-breeding work has been successful in providing strains which resist certain pests and diseases. The problem of saving the early rice crop in the United Provinces from the rice fly, *gundhi*, which by sucking the grain destroys the crop over extensive areas, has been handled by crossing prolific grained strains with a coarse grained and early poor yielding type known as *Sathi* which by virtue of a leaf covering the ear-head escapes the attacks. Hybrid strains immune to the fly have now been bred. They are superior to *Sathi* in yield and fineness of grain and earlier than the types under distribution.

In certain rice areas self-sown wild rice is a nuisance. To enable it to be recognised and pulled out at an early stage in the Central Provinces, strains have been evolved as a result of hybridisation, which are more prolific in yield and can be distinguished from wild rice by a distinctive colour in the early stages. The seeds of these hybrids have been distributed and have met with success.

To criticise programmes, to study results and to help in deciding policy, there is a standing Rice Committee of the *Imperial Council of Agricultural Research*, on which all interests are represented. The Committee not only co-ordinates research, but also makes sure that research is adapted to the needs of the cultivator and the trade.

* * *

Vegetable Insecticides.—The Industrial Section of the *Indian Museum, Calcutta* (Botanical Survey of India) has recently acquired and placed on show specimens of *Derris root*, commercially known as Tuba root, and flowers and plants of Pyrethrum. The *Derris root* and Pyrethrum flowers are considered to be essential ingredients in insecticidal preparations used as dust or spray.

The *Derris roots* have been obtained from Assam, Bangalore and the Central Experimental Station at Serdang in the Federated Malay States, and the Pyrethrum plants and flowers from Kashmir and the Murree Hills of the Punjab. Some Pyrethrum flowers have also been received from Harpenden in the United Kingdom and Kenya. To make the exhibits attractive, pictures of the plant specimens drawn in their natural colours have been placed by their side.

More efficacious and less costly to produce, there has been in recent years a growing world demand for insecticides of vegetable origin, which are comparatively harmless to human beings, to replace more dangerous arsenical and other chemical preparations.

Insecticidal preparations from Derris have been tried with success in Assam against biting and sucking insects and in Madras against caterpillars which damage the cabbage crops. In Bengal, too, a preparation has been tried as spray against mango leaf hopper and found efficacious, but the cost is reported to be high.

Attempts are being made to cultivate "Tuba" in several parts of India; the plant grown in Mysore, in particular, has been found to give a good yield of rotenone, the active principle on which depends the value of these products as insecticides.

* * *

Electro-Magnetic Grain Cleaner.—The electro-magnetic seed cleaning is based on the observation that many wild seeds, particles of stubble and broken grain have a rougher surface as compared to that of good seeds. When the seeds are mixed with fine iron powder, the iron adheres to the rough surface and can be separated away from smooth-surfaced good grains by passing over magnetic cylinders. In

actual practice, steel dust is employed and a small quantity of liquid medium, either water or a mixture of castor and olive oils, is used to increase the adherence of the powder to the rough surface of the useless material.

* * *

Biological Control in the Lac Industry.—Lac insects are subject to the attack of two classes of enemies, internal parasites and external parasites and external predators, whose control is a factor of major importance in the commercial production of lac. The practicability of biological control of these enemies is discussed in a paper by Glover and Gupta in a contribution published by them in a recent number of the *Indian Journal of Agricultural Science* (1939, 19, 523). According to these authors, predators constitute the more destructive agents affecting about 30–40 per cent. of lac cells. The emphatic statement that the damage done by parasites is small (4·8 per cent.) may be questioned by other experienced workers in the field, whose work as is customary with these authors, has been ignored. They refer to the "recently discovered egg parasites of lac predators" the practical demonstration of whose effectiveness will be awaited with keen interest.

* * *

Indian Central Cotton Committee.—The *Annual Report* for the year ending 31st May 1939, which we have just received, provides an impressive record of service rendered to the Indian Cotton Industry. The spinning value of 635 samples of new cottons has been determined thus providing the various provincial agricultural departments, as well as others, with complete and authoritative reports on the spinning value of their products. Many samples of yarn, cloth and cotton were received for fibre tests as also some samples for moisture tests and dye absorption tests. In addition, tests on trade samples, samples from cotton mills and Indian standard cottons were carried out. Many of these tests are of a routine nature, such as the determination of tensile strength of cloth or yarn, determination of actual counts, number of turns per inch, reed and pick, etc., but some of the interesting features met with in the course of testing these samples are mentioned in the Report.

Several technological tests such as the effect of fibre weight on spinning quality of Indian cottons, effects of storage on the quality of Indian cottons, have been carried out and reported during the period under review, in the form of technological bulletins and circulars. For the interested public, two small brochures have also been issued from the Laboratory.

Summaries of technological bulletins as also a list of tests which may be carried out for the trade on payments are found in the Report.

It is gratifying that in about two years time, the number of samples received has increased by 50 per cent.; but the total number of samples received is not commensurate with the large volume of the industry. It is to be hoped that in the coming years, the cotton mills and firms will take greater and greater advantage of the facilities offered by this official testing house of the Indian Textile Industry. P. S. S.

The League of Nations' World Economic Survey, 1938/39 (Ser. L.o.N. P., 1939, II A. 247 pages) was completed on the eve of the outbreak of hostilities in Europe. According to a communique issued by the Information Section, it covers events up to beginning of August 1939, and thus presents a picture of the world economic situation up to the date of the beginning of hostilities. During the first months of 1939 the world was making a rapid recovery from the major depression with which it had been threatened in the first half of 1938. This rapid reversal of economic conditions may be ascribed in part to financial measures taken in the United States of America and in other countries in order to stimulate the lagging demand for goods and services. But in the main it was due to increased expenditure on armaments and war preparations.

This issue—the eighth in the series—includes a number of special studies. One chapter, for example, is devoted to a study of the economic effects of recent changes in the trends of population.

A second chapter studies the problems of public finance, and examines the extent to which the costs of rearmament have eaten into the national incomes of various countries.

The concluding chapter, entitled "The Economic Effects of War, Rearmament and Territorial Changes" summarises the main theme of the volume. Economic destruction in Spain and China and the reduction in the standard of living in Japan as a result of war; the economic effects of the territorial expansion of Germany; and the greatly increased intervention of the State in economic affairs for the purposes of national defence;—these are the main subjects of the chapter. In various other chapters the growing importance of political tension and of rearmament is emphasised in their effects on economic activity, on world trade, on hours of work and the demand for labour, on budgetary and monetary policies, and on commercial relations between the nations.

* * *

Business Cycles in the United States of America, 1919-1932.—The Economic Intelligence Service of the *League of Nations* has just published the second volume of the series "Statistical Testing of Business-cycle Theories" dealing with the business cycle in the United States of America from 1919 to 1932. According to a communique from the Information Section of the *League of Nations*, this volume applies the system of mathematical analysis described in the first volume to the post-War trade data of the United States. It aims at determining on the basis of existing statistics and with the help of the "multiple correlation method," the more important quantitative relationships which have governed the economic system of the United States of America during the period under review. In this way, some forty equations are found, which are thought to represent the main characteristics of the mechanism of the United States business cycles in that period. The combination of these equations by mathematical treatment ("elimination process") yields one "final" equation, from which

emerges the general nature of the United States cycle (*cf. Curr. Sci.*, 1939, 8, 192).

* * *

Scientific Expedition to Central Pacific.—The expedition sponsored by the *National Geographic Society and the University of Virginia with the U.S. Coast Guard co-operating* (*cf.* this *Journal*, 1939, 8, 391, 493), has been indefinitely postponed, owing to the outbreak of war in Europe. According to a communique issued by the *National Geographic Society*, the expedition was to have sailed from San Francisco on September 19 on the Coast Guard cutter *Hamilton*, but plans had to be shelved when the *Hamilton* was ordered to Atlantic waters as part of the coast patrol established by President Roosevelt to preserve American neutrality.

Tons of scientific equipment had been shipped to the Pacific Coast to be loaded on the *Hamilton*, and scientist members of the expedition had spent months of intensive work preparing apparatus for studying geology, magnetism of the earth, variations in gravity, earthquakes, marine biology, weather, ocean currents, and for collecting samples of the ocean bottom from great depths. The expedition was to have conducted the most extensive programme of scientific work ever attempted in the Pacific Islands region.

Most of the expedition's apparatus now is being shipped back to scientific laboratories, universities, and government agencies which supplied it. Some of the supplies will be stored for future use when the expedition can proceed, and perishable materials will be sold.

Prof. Wilbur A. Nelson, leader of the expedition, will return to his duties as Professor of Geology at the University of Virginia to await conditions better suited to scientific research on the high seas.

* * *

A Phytogeographic Map for India.—At the ordinary meeting of the *Royal Asiatic Society of Bengal* held on Monday, 6th November, Dr. D. Chatterjee presented a paper on his studies relating to the endemic flora of India and Burma. The author has traced the relationships of the various groups of Indian plants with those of the surrounding countries, and also discussed the nature of invasion of foreign plants into India. The author states, "In a continental area, it is unusual to find a high degree of endemism but 61·5 per cent. of Indian plants has been found to be endemic. A possible explanation based mainly on the theory of isolation has been put forward in the present case. The endemic species have been found in high concentration in three regions: (*a*) The Himalayas, (*b*) South India, and (*c*) Burma".

* * *

The following students of the **Imperial Agricultural Research Institute, New Delhi**, have been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after the completion in 1939 of their two-year post-graduate courses and the acceptance by the Institute Council of theses submitted by them in the subjects noted against each:—

(1) Atamaram Bhairav Joshi (Botany); (2) G. Suryanarayana Murti (Botany); (3) Ram Mohan Arora (Botany); (4) Sham Lall Juneja (Botany); (5) W. V. B. Sundara Rao (Agricultural Chemistry); (6) Abhiswar Sinha (Agricultural Chemistry); (7) Atam Prakash Kapur (Entomology); (8) Raghubir Sahai Mathur (Mycology); and (9) S. Y. Padmanabhan (Mycology).

* * *

National Institute of Sciences of India.—The following gentlemen have been elected Fellows of the Institute:—*Ordinary Fellows*: (1) Dr. K. Banerjee, D.Sc., Reader in Physics, Dacca University. (2) Prof. F. R. Bharucha, B.A., B.Sc., D.Sc., Professor and Head of the Department of Botany, Royal Institute of Science, Bombay. (3) Dr. R. N. Ghosh, D.Sc., Reader in Physics, Allahabad University. (4) Prof. H. K. Mookerjee, D.Sc., D.I.C., University Professor and Head of the Department of Zoology, Calcutta University. (5) Prof. V. V. Narlikar, B.Sc. (Bom.), B.A. (Cantab.), F.R.A.S., Professor and Head of the Department of Mathematics, Benares Hindu University. (6) Dr. C. G. Pandit, M.B.B.S., Ph.D., D.P.H., D.T.M., Offg. Director, King Institute of Preventive Medicine, Guindy, Madras. (7) Major C. L. Parischa, I.M.S., Professor of Pathology and Bacteriology, School of Tropical Medicine, Calcutta. (8) Prof. L. Rama Rao, M.A., F.G.S., Professor of Geology, Mysore University. (9) Dr. M. Shariff, D.Sc., Ph.D., Entomologist, Haffkine Institute, Bombay. (10) Dr. K. Venkataraman, M.Sc., (Tech.), Ph.D., D.Sc., Director, Bombay University Laboratories of Chemical Technology and Textile Chemistry.

Honorary Fellows: (1) Dr. E. V. Appleton, M.A., D.Sc., F.R.S., Secretary, Department of Scientific and Industrial Research of Great Britain. (2) Prof. Charles W. Edmunds, A.B., M.D., Professor of Pharmacology and Therapeutics, University of Michigan Medical School, U.S.A. (3) Prof. R. A. Fisher, Sc.D., F.R.S., Galton Professor in the University of London. (4) Prof. Waldemar Lindgren, Emeritus Professor of Geology, Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.

* * *

Herbert Akroyd Stuart Award, 1937-39.—Information has been received at Calcutta that Mr. S. N. Mukerji, M.Sc., A.M.I.E. (Ind.), a member of the Research Staff, *Government Test House, Alipore*, has been awarded the prize of £50 under the above award for his paper on "The Origin and Development of Heavy-Oil Engines". The award is provided under the will of the late Herbert Akroyd Stuart, a pioneer in the development of oil engines, bequeathed to the *Institute of Marine Engineers*, London, for the best paper by a member or non-member on the subject above referred to. The award is given every two years. The Awards Committee reported that the 'entries received on this occasion were of a very high standard of merit', and they have specially complimented Mr. Mukerji on his excellent essay. Owing to the difficulty of distance the requirement that the winning paper shall be read at a meeting of the Institute has been waived and the paper will be published in the November issue of the Institute's *Transactions*.

* * *

University of Mysore.—I. GENERAL: The Senate, the Academic Council and the University Council were reconstituted for a period of three years (1939–42). II. CONVOCATION: The Twenty-second Annual Convocation for conferring degrees was held on the 25th October 1939, His Highness the Chancellor presiding. Sir Nripendranath Sirkar, K.C.S.I., delivered the Convocation Address. III. MEETING OF THE ACADEMIC COUNCIL: The first ordinary meeting of the Academic Council was held on 8th September 1939. The propositions that were passed at the meeting of the Academic Council held on the 8th September 1939 included—one relating to the institution of course of study in Chemical Engineering, and another relating to the institution of French and Latin as second languages which may be offered at a University Examination provided satisfactory arrangement for instruction is made by the candidates themselves. IV. LECTURES: The Sri Krishnarajendra Silver Jubilee Lecture of a previous year was delivered by Sir T. Vijayaraghavacharya, K.B.E., at Bangalore on the 1st September and that for the current year by Sir Alladi Krishnaswami Aiyar on 30th September 1939, the subjects being "Scientific Research in Agriculture" and "Law as an Instrument and Measure of Social Progress" respectively. V. EXAMINATION: The results of the L.M.P. Examinations held in October 1939 were published. They were as follows:—

	Number Examined	Passed
First L.M.P. ..	14	7
Second L.M.P. ..	25	14
Third L.M.P. ..	40	19
Final L.M.P. ..	43	18

Announcements

The 11th Session of the **Indian Mathematical Conference** will be held at Hyderabad under the auspices of the Osmania University from 21st to 23rd December 1939. Apart from the reading of papers, two Symposia will be held on (1) "Generalised Geometry, including Relativity and Field Theory", and on (2) "Warring's Problem". A discussion on the Teaching of Mathematics in Schools and Colleges will also be held. Three public lectures will be delivered, the subjects being (1) Meteoric Astronomy; (2) Mathematical Recreations; and (3) Mathematics, the Handmaid of Arts, Science and Economics.

Excursions, specially to the famous Ellora and Ajanta Caves, are also being arranged.

Those who wish to attend the Conference can communicate with the Local Secretary, Department of Mathematics, Osmania University, Lalaguda, Hyderabad (Deccan).

All-India Sugar Conference.—The Government of India have decided to convene an All-India Sugar Conference representing all interests, at an early date. It will consider measures for the rationalisation and stabilisation of the sugar industry.

Items such as the regulation of cane production, payment of premium for special varieties of cane, legislation for zoning, licensing of factories, establishment of industries subsidiary to sugar and of a central marketing organisation, etc., have been recommended by the Sugar Committee and the Advisory Board of the *Imperial Council of Agricultural Research*. These items will be referred to the proposed All-India Sugar Conference.

Science Progress.—The Editors and Publishers (Messrs. Edward Arnold & Co.) of this well-known quarterly review, founded by Sir Ronald Ross in 1907, announce with regret that the October number will be the last to appear for the present. The purpose of the review is to record recent advances in pure science and to publish articles by those who have played a leading part in such work. Research of this kind is bound to be seriously diminished in wartime, and therefore it has been reluctantly decided to suspend publication until conditions are more favourable.

An article by Sir Arthur Eddington on "The Cosmological Controversy" is a notable feature of the October number.

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We acknowledge with thanks receipt of the following:—

"Journal of Agricultural Research," Vol. 59, No. 3.

"Agriculture and Live-Stock in India," Vol. 9, Pt. 5.

"The Philippine Agriculturist," Vol. 28, No. 5.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 9.

"L'Agricultura Coloniale," Vol. 33, No. 7.

"Biochemical Journal," Vol. 33, No. 8.

"Contributions from Boyce Thompson Institute," Vol. 10, No. 4.

"Journal of Chemical Physics," Vol. 7, No. 9.

"Comptes Rendus," (DOKLADY), Vol. 24, Nos. 3–4.

"Experiment Station Record," Vol. 81, No. 3.

"Indian Forester," Vol. 65, No. 11.

"Forschungen und Fortschritte," Vol. 15, No. 23/24.

"Genetics," Vol. 24, No. 5.

"Review of Applied Mycology," Vol. 18, No. 9.

"Calcutta Medical Journal," Vol. 36, No. 4.

"The Mathematics Student," Vol. 7, No. 2.

"The Bulletin of the American Meteorological Society," Vol. 20, No. 7.

"Journal of the Indian Mathematical Society," Vol. 3, No. 7.

"Indian Medical Gazette," Vol. 74, No. 10.

"Nature," Vol. 145, No. 3646.

"American Museum of Natural History," Vol. 44, No. 2.

"Proceedings, Royal Netherlands Academy," Amsterdam, Vol. 42, No. 6.

"Indian Journal of Physics," Vol. 13, No. 4.

"Sky," Vol. 3, No. 11.

"Indian Trade Journal," Vol. 135, Nos. 1738, 1740–41.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 9, Pt. III.

ACADEMIES AND SOCIETIES

National Institute of Sciences of India, Calcutta:

August 25–26, 1939.—R. R. BAJPAI AND K. B. MATHUR: *Absorption of electromagnetic waves in the earth's atmosphere.* B. N. SRIVASTAVA: *Heat of ionic dissociation of the chloride and bromide of rubidium.* K. B. MATHUR: *Absorption and reflection of radio waves of oblique incidence and their relationship with vertical incidence phenomena.* M. ISHAQ: *The extension of the (O, O) band of OD.*

SYMPOSIUM ON COAL IN INDIA

E. R. GEE: *History of the development of the coal industry; The history of coal-mining in India; The geology of Indian coal.* M. S. KRISHNAN: *India's coal reserves; India's position in the world as a coal producer; Conservation of coal.* CYRIL S. FOX: *Coal in relation to metallurgical operations; Coal in relation to power.* B. WILSON HAIGH: *Carbonisation of coal and recovery of by-products.* W. J. SAVAGE: *Carbonisation of coal.* S. K. ROY AND S. S. GHOSH: *Fuel oil from inferior Jharia coals.* C. FORRESTER: *Briquetting of coal in India.* A. N. MUKHERJEE: *Briquetting of coal.* CYRIL S. FOX: *The underground gasification of coal.* N. N. CHATTERJEE: *Domestic coke.* C. FORRESTER: *Domestic coke.* N. N. CHATTERJEE: *Fuel research.* C. FORRESTER: *Fuel research in India.* CYRIL S. FOX: *Fuel research: Indian coal.* H. K. NAG: *Safety in mines through education.* E. B. PARK: *Safety in coal mining.* R. P. SINHA: *Safety in coal mining.* L. J. BARRACLOUGH: *Packing with incombustible material in coal mines.* W. KIRBY: *Some physical conditions which affect spontaneous heating in coal mines.* E. B. PARK: *Fires and ignition in mines.* C. FORRESTER: *Storage of coal.* E. R. GEE: *Storage of coal.* C. A. INNES: *Indian export trade in coal; The marketing of coal in India.* A. L. OJHA: *Some problems of Indian coal.* N. N. CHATTERJEE: *Chemical constitution of coal; Methods of analysis of coal.* C. FORRESTER: *Methods of analysis of coal in India.* J. SANJANA: *Sampling of coal.* C. FORRESTER: *Coal cleaning and benefication in India.* E. R. GEE: *Coal cleaning and beneficiation.* N. N. CHATTERJEE: *Sulphur in coal.* E. R. GEE: *Moisture in coal.* J. S. SANJANA: *Moisture in coal.* R. K. DUTTA ROY: *A critical study of some Indian coal ashes.* J. S. SANJANA: *Ash in coal.* C. FORRESTER: *Volatile matter in coal.* M. S. KRISHNAN: *Classification of coal.* N. N. CHATTERJEE: *Micro-structure of some Indian fusains.* S. K. ROY: *Microscopic determination of the Barakar and Raniganj sandstones of the Jharia coalfield.* C. MAHADEVAN: *Studies in coal by X-ray diffraction methods.* R. K. DUTTA ROY: *Studies on the action of solvents on Indian coal.* B. SAHNI: *The Palæobotanical correlation of coal seams in India.* M. S. KRISHNAN: *State control in the coal industry.* D. D. THACKER: *The present status of the coal industry.*

Indian Academy of Sciences:

October 1939. SECTION A.—H. J. BHABHA, H. CARMICHAEL AND C. N. CHOU: *Production of bursts and the spin of the meson.* S. BHAGAVANTAM: *On the occurrence of overtone lines in Raman effect.*—It should be quite possible to record the overtone of the hydrogen frequency at approximately double the normal Raman shift as its intensity is expected to be only 1/155 of that of the fundamental. V. R. THIRUVENKATA CHAR: *Note on some formulæ involving the Laguerre and Hermitian polynomials and Bessel functions.* S. RAMACHANDRA RAO AND S. R. GOVINDARAJAN: *The crystal diamagnetism of tellurium.*—The principal susceptibilities are found to be $-0{\cdot}329$ parallel to the trigonal axis and $-0{\cdot}296$ perpendicular to same, leading to 1·11 for magnetic anisotropy. Influence of temperature and small admixtures of other elements have been studied. K. BAPAYYA: *A study of the continuous wings occurring in Raman effect.*—Besides the optical anisotropy, other physical properties of the liquid, such as its viscosity and dipole association play a prominent part in determining the intensity of the wings. W. BUKHSH AND R. D. DESAI: *Heterocyclic compounds—Part X. The synthesis of substituted* 1 : 2 : 3 : 4*-tetrahydroacridones.* P. SURYAPRAKASA RAO, V. D. NAGESWARA SASTRI AND T. R. SESHADRI: *Geometrical inversion in the acids derived from the coumarins—Part VII. The behaviour of acetyl coumaric acids.* D. N. MOGHE: *On isotropic manifolds in the theory of relativity.* R. K. MEHRA AND K. C. PANDYA: *The condensation of aldehydes with amides—Part IV. Of* m*-hydroxybenzaldehyde.* M. MANZUR AND K. C. PANDYA: *The condensation of aldehydes with amides—Part V. Of* p*-hydroxybenzaldehyde.* R. K. MEHRA AND K. C. PANDYA: *The condensation of aldehydes with amides—Part VI. The condensations of* o-, m- *and* p*-methoxybenzaldehydes.* K. SUBBARAMAIAH: *Studies in colloid optics—III. Scattering of light by stearic acid hydrosols and by sodium stearate sols and gels.*—The micelles in stearic acid sol are appreciably large and increase continuously on heating due probably to partial coagulation by heat. The asymmetry in shape of micelles diminishes with rise in temperature. A. MOESSNER: *Einige numerische Identitaten.* G. V. L. N. MURTY AND T. R. SESHADRI: *Raman effect and chemical constitution. Influence of constitutive and other factors on the double* bonds in organic compounds.—Part II. *Effect of the phenyl group on the carbonyl bond in esters.* —The phenyl group attached directly to the carbon of the C = O group as in esters of aromatic acids and in aromatic ketones, etc., markedly lowers the carboxyl frequency whereas the same group attached to the C = O through an oxygen atom as in phenyl esters markedly enhances the frequency.

October 1939. SECTION B.—G. N. RANGASWAMI AYYANGAR AND B. W. X. PONNAIYA: *Studies in* Sorghum sudanense, *Stapf.—The Sudan Grass.* G. W. CHIPLONKER: *Lemellibranchs from the Bagh Beds.* MANOHAR LAL MISRA: *On some stone implements from Hoshangabad (Central Provinces).*

1776-39—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.